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Three Mekarski compressed air street cars have been running in Westfield, Mass., for about a month and are reported to be doing good service and giving excellent satisfaction. On July 4 a very heavy traffic was carried, from 40 to 74 people per car, but the round trips, four miles in length, were made without interruption or difficulty. As announced in these columns some time ago, this system has been taken up by a company organized by Messrs. Jas. F. Lewis, of the Rand Drill Co.; Mr. C. B. Johnson, President of the Wilson & Baillie Mfg. Co., of Brooklyn, and other well-known men.

Street car fenders may be required on the roads of Washington, D. C., a bill having been presented to compel the street railway companies to equip their cars with such devices. Accompanying the bill was a report from the District commissioners to the District committee, stating that it was doubtful whether any of the street railways have adopted the most effective fender practicable for the protection of human life and limb. All the fenders are of fixed kind, and consist of shields placed in front of the forward wheels or inclosing the wheel base. The defects are their rigidity and their height above the track level and position well under the body of the car, instead of being close to the rail and not projecting beyond or inclosing the whole body of the car. A person may be caught under the car before the fender touches him or may be forced under the fender when knocked down. The height of the rigid fender seems to be unavoidable on account of the oscillation of the car when moving rapidly and of the existence above the track's level of projections in the roadbed. Even on certain asphalt streets there are projections 1½ ins. above the pavement of iron constructions pertaining to cable conduits. A first step toward the use of more efficient fenders is the depression of these and all other similar projections to the level of the pavement. The commissioners have inspected numerous models, but no device has been found which is regarded as sufficiently meritorious and surely practicable to warrant them in requiring the street car companies, even if authority therefor existed, to equip the cars with it.

Rapid progress continues to be made on the East River Gas Company's tunnel under the East River. On the week ending June 27, 1894, the day shift made 48.6 ft. advance and the night shift 52.6 ft., or a total progress for the week, on one heading, of 101 ft. The tunnel is 10 ft. 6 ins. × 8 ft. 6 ins., and is now in very hard hornblende gneiss. Four 3½ in. Ingersoll-Sergeant drills are used in the heading, mounted on tunnel columns with arms; two drills on each column. About 15 holes, 9 to 10 ft. deep, are drilled by each shift, consisting of five machine runners, and their helpers. Compressed air for running the drills and pumps, and also for ventilation is supplied by an Ingersoll-Sergeant air compressor, of the latest improved piston-inlet type, straight line pattern, having cylinders 20 × 24 ins. and furnishing about 1,050 cu. ft. of free air per minute. In our issue of May 24 a progress of 94½ ft. in one week on the Long Island heading of this tunnel was recorded. An illustrated description of the tunnel was given in our issue of March 1, 1894. Mr. Chas. M. Jacobs is the Chief Engineer of the work, and Mr. G. B. Fry is Superintendent of the rock excavation.

It is reported that a large tunnel, to drain 15 collieries in the anthracite region, is being driven at Jeddo, near Hazleton, Pa., The length of the tunnel is given as five miles.

The law passed in the closing hours of the Massachusetts legislature incorporating the Boston Elevated Ry. Co. does not provide for the construction of the Meigs system necessarily. The company can construct a railway on the Meigs system or on any other system which it desires, provided only that it may not build structures similar to those of the Manhattan Ry. in New York. Just what this restriction covers it would be difficult to say, as the Manhattan system includes structures of half a dozen or more different types. The company is made subject to all past and future laws respecting railroad corporations, payment for land damages is secured, and some return to the public for the franchise is provided for. The sections of the bill providing for the construction of the Tremont St. subway are taken direct from the original bill prepared under direction of the city authorities of Boston, which provide in general that the subway is to be constructed, owned and operated by the city. Neither the subway nor the elevated system can be constructed, however, unless the bill is approved by a popular vote.

At a meeting of the new Rapid Transit Commission of this city on July 10 the chief engineer, Mr. Wm. Barclay Parsons, M. Am. Soc. C. E., and the counsel were instructed to report on July 17 whether there are any engineering or legal obstacles which would prevent the present commission from adopting the plans of the old commission, organized under the act of 1891. Unless the old plans are adopted, the question of municipal construction of the proposed system cannot be voted on at the next November election. The plans adopted by the old commission were published in our issues of Nov. 24 and Dec. 1, 1892.

Perhaps the great amount of "strike news" which has filled the papers for a week past has crowded out the reports of railway accidents from ordinary causes, as the list this week has been very limited. The most serious railway accident of the week was a rear collision, July 8, at Wann, Ill., on the Cleveland, Cincinnati, Chicago & St. Louis Ry. A freight train had not pulled far enough into the side track and the caboose was struck by an express train. The engineman and fireman were badly injured.——Another serious accident was the derailment of a northbound express train on the New York Central R. R. at Yonkers, N. Y., July 7. Just below Yonkers the train passed a freight train, one of the car doors of which had fallen off and lay upon the northbound track. The engine ran along the ties for some distance and then struck the abutment of the Wells Ave. bridge, turning completely over. The engineman and fireman jumped and the passengers escaped with a severe shaking.

The main buildings of the Columbian Exposition were practically destroyed by fire on July 5. The Manufactures, Mining, Electricity, Machinery, Agricultural and Administration buildings and the terminal railway station, were destroyed, and the Transportation and Government buildings were only saved by great efforts on the part of the firemen. The fire began in the terminal station and flying brands and timbers set the other buildings burning. The enormous arched roof trusses of the Manufactures Building fell in with a great crash.

An immense amount of damage to railway track, rolling stock and other property has been done by the strikers at Chicago, track being pulled up, trains derailed, cars burned, etc. Of course the leaders disclaim responsibility, which is as though men who set fire to a heap of inflammable material in one room of a house should say they were not responsible for the destruction of the house.

A cylinder head of the engines of the U. S. cruiser "Montgomery" blew out July 3 while the vessel was being given sea trials to test her stability.

Tar filling in a brick pavement on Tryon Place, Danforth St. and Dart St., Buffalo, N. Y., became melted recently and ran into the gutters. The specifications for the pavement called for the filling of the joints:

"With coal-tar paving cement known as No. 4, which must be heated and poured at a temperature of not less than 300° F., filling the joints full, after which and while the pitch is hot, coarse clean sand be spread on the surface of the pavement to the depth of ½ in."

The melting and running of the filling were probably due to the use of too soft a grade of tar.

Eighteen "porcupine" boilers in the power house of the Missouri Electric Light & Power Co., St. Louis, Mo., have been condemned and taken out and Heine water-tube boilers will be substituted in their place. The arc dynamos installed only a few years ago are also to be removed and machines of larger capacity coupled direct to large Corliss engines are to be substituted.

Marine boiler builders and users will be interested in a bill which has just passed the House of Representatives, and which amends Section 4,434 of the Revised Statutes to read as follows:

No externally-fired boiler having its shell constructed of iron or steel plates exceeding an average thickness of 0.30 in. shall be employed on any steam vessel navigating the Red River of the North, or rivers flowing into the Gulf of Mexico or their tributaries; and no externally fired boiler employed on any such steam vessels shall have less than 3 ins. space between its shell and any of its internal flues, and not less than 3 ins. space between such flues when any such flues are more than 5 ins. in diameter; and every such externally fired boiler employed on any such steam vessel shall be provided with a manhole, in the lower part of the front head thereof, of such dimensions as may be prescribed by the Board of Supervising Inspectors, in all cases where the distance between its internal flues is less than 3 ins. Externally fired boilers having shells constructed of iron or steel plates not exceeding an average thickness of 0.50 in. may, in the discretion of the Secretary of the Treasury, be authorized and employed on steam vessels navigating the Atlantic and Pacific oceans or salt water bays or sounds, or the great lakes, or any of them, and water flowing to and from the same, or any of them; provided that in inspection, no plate that is by this act limited to a thickness of 0.30 in. and no plate that is by this act limited to a thickness of 0.50 in. shall be rejected for use if found to exceed these dimensions, respectively, if the average thickness thereof does not exceed the limits therein specified, and the amount of steam pressure that will be permitted to be carried in boilers constructed in accordance with the requirements of this act shall be determined from measurement showing the least thickness of the plates.

The Huron-Ottawa ship canal scheme is again being agitated by the Ottawa Board of Trade. The endeavor is to have the Dominion Government appropriate funds for making a preliminary survey of the route, with an estimate of cost. Mr. P. D. Ross, of Ottawa, is chairman of the committee having the matter in charge.

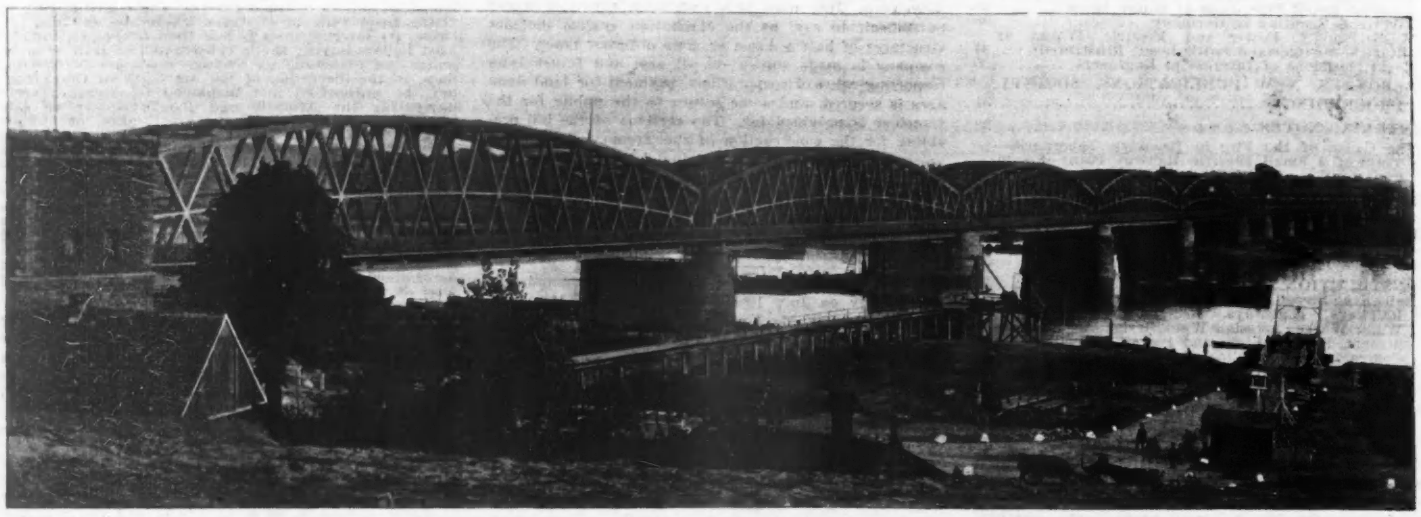
The canal on the Canadian side of the Sault Ste. Marie will be opened for traffic within a few weeks. Its total length is 18,100 ft., of which 3,500 ft. is the distance across St. Mary's Island. The lock chamber is 900 ft. in length, 60 ft. in width, and the depth of water on the sills is 20 ft. 3 ins. at low water mark. The canal itself is 152 ft. wide at the water line, and 145 ft. wide at the bottom. The first contracts for the work were let in 1889, and up to Dec. 31, 1893, the total amount expended had been $2,243,890. Up to June 30, 1893, the Dominion of Canada had expended a total of $71,310,793 on its canals and had received from them a total revenue of $9,850,579.

The Seattle & Lake Washington Water-Way Co. is being organized at Seattle, Wash., to construct the proposed ship canal from Seattle Harbor to Lake Washington and carry out the necessary improvements to the harbor and the tidal flats adjoining the city. This company proposes to carry out the work substantially on the plans recommended by Capt. Thos. W. Symons, U. S. Engineer Corps, which will require an entire modification of the harbor lines and waterways. Beginning at deep water in the harbor two channels are to be cut south to a connection with the Duwamish River. These channels will be 2,000 ft. apart and of sufficient width to allow of ships being constructed along their sides. The depth of the channels will be 22 ft. The canal to Lake Washington will enter the east channel through a lock. It is stated that the excavation of the canal will be entirely through glacial drift, with practically no rock work. All the material taken from the excavation of the canal and harbor channels is to be used in filling up the low tidal flats and thus reclaiming them for business purposes. It is stated that all the harbor excavation can be done with hydraulic dredges, and it is expected that the inflow of fresh water from the canal and the Duwamish River will enable timber to be used for the locks and docks without much danger from destruction by the teredo. The estimated cost of the work is $5,000,000. Ex-Governor Elisha P. Ferry, of Seattle, Wash., is stated to be the President of the new company. A description of earlier plans was given in our issue of March 15, 1894.

The Harney Peak Tin Mining Co. has been placed in the hands of Dr. A. R. Ledoux as Receiver on petition of a number of English stockholders. The company was organized in 1884 and has issued stock to the amount of $15,000,000. Most of the money actually paid in has come from the English investors. The company has spent a large amount in the erection of mills, houses for employees, costly machinery, etc.; and bought some 400 mining claims, of which only 20 or more have ever been worked to any extent. A considerable amount of ore has been mined, but no tin, or none of any amount, has ever been marketed. Reports on the company's properties were given in our issues of Sept. 1 and Nov. 24, 1892.

## THE LARGEST BRIDGE IN GERMANY.

We show herewith a general view of the long steel railway and highway bridge which was constructed over the Weichsel River, near Fordon, Germany, late in 1893, and which is said to be the largest bridge in Germany. The bridge was built after designs prepared by Government Engineer Mehrtens, of Bromberg. The total length of the bridge is 4,346 ft., and it is divided into five river spans, each 328 ft. long, and 13 shore spans, each 203.4 ft. long, all carried on masonry piers. Each of the five river spans consists of two trusses, with curved top chords and a double triangular web system, braced at the points of intersection of the web members by a curved strut. The clear distance between trusses is 35.42 ft., of which 21.32 ft. is occupied by the roadway and 13.6 ft. by the railway track. The roadway and the railway tracks are



STEEL RAILWAY AND HIGHWAY BRIDGE OVER THE WEICHSEL RIVER NEAR FORDON, GERMANY.

separated by an iron railing, and two sidewalks, supported by brackets on the outside of the trusses, serve for pedestrians. Both the roadway and sidewalks have plank floors, and the floor of the roadway is slightly elevated above the level of the railway tracks. As will be noticed from the illustration, each span is provided with a traveler, suspended from the bottom chords of the trusses. This is to be used for inspection, painting, etc. A similar traveler can also be mounted on the longitudinal curved struts at the intersection of the web members when desired. The entire superstructure is of basic steel, 13,200,000 lbs. being basic Bessemer steel and 35,200,000 lbs. basic open hearth steel. The total cost of the bridge was $2,100,000, and the time occupied in its construction was 2½ years.

## TESTS OF A SMALL ELECTRIC RAILWAY PLANT.*

By Jesse M. Smith.

This paper is designed to give in a concise form the results of a test made in October, 1893, on the power plant of the Wyandotte & Detroit River R. R., a suburban road running from Detroit to Trenton, Mich., 10.5 miles long.

The plant contains two tandem compound condensing engines rated at 150 HP. each, and guaranteed for a maximum load of 225 HP., made by the Phoenix Iron Works Co., Meadville, Pa. Each engine is belted direct to a Westinghouse railway generator of 150 E. HP. The vacuum is obtained by a Conover air pump and condenser belted directly to the engine shaft. The boiler feed pump is driven from the air pump shaft. Steam is supplied by two Manning vertical boilers. One engine and dynamo only were used during the test. It will be noted at the outset that each engine and dynamo is designed to deliver an average of 150 HP., but that during the test the average load on the engine was only 70 I. HP., and the maximum 141 I. HP. The best conditions of economy were therefore not realized. The test was made under commercial conditions for the owners of the plant. All the machinery had been run about three months and no adjustments by the makers had been made since it was first put in. No special care had been taken to get very close regulation either of the engine or generator. One boiler was fired with coal, and used exclusively to supply steam for the fuel atomizer of the other boiler. "Straight crude oil" was used exclusively as fuel for the boiler, which supplied steam to the engine, and no steam was used from that boiler for other purposes. Indicator cards were taken at intervals of 5 minutes during the 17⅓ hours of the test. A Tabor indicator was applied directly to each end of each cylinder, and all operated by the same mechanism. Indicator cards were taken simultaneously from the four indicators by two persons on a signal given at the proper time, without regard to the load on the engine. The speed of the engine was determined by a continuous revolution counter which was directly connected to the shaft of the engine. The variation of speed was shown by a tachometer belted directly to the engine shaft, and constantly in service. It was carefully compared with the revolution counter when on constant speed, and was made to agree with the counter. The speed of the dynamo was taken at four different times by a revolution counter held in the end of the shaft for five consecutive minutes each time. Three readings gave 604 revolutions, and one reading gave 603 revolutions per minute. The speed of the air pump was taken in the same way.

The amperes were measured by a Weston standard ammeter connected in series with the station ammeter. The volts were measured by a Weston standard voltmeter connected to the bus bars of the switchboard. Volt and ampere readings were taken every ten seconds by a different person at each instrument, the time being given by a third person.

The water used by the boilers was taken from the overflow of the air pump, and weighed in two barrels on two scales, and was pumped from the barrels by the regular feed pump worked from the shaft of the air pump. The feed water passed through a closed heater with brass tubes, the heater being connected with the exhaust pipe between the engine and condenser. The fuel oil was stored and fed by the Snell water pressure system. The amount of fuel oil fed to the atomizer was measured by measuring the number of gallons of water which flowed into the storage tank.

Boilers.—The two Manning vertical tubular boilers were rated at 150 HP. The firebox was 6 ft. in diameter and 3 ft. 6 ins. high with 89.2 sq. ft. heating surface. Each boiler had 184 tubes 2½ ins. in diameter and 14 ft. 10 ins. long, of which 10 ft. 7 ins. was below the water line. The total tube heating surface was 1,272.7 sq. ft., of which 511 sq. ft. was above water line.

Engines.—The cylinders of the engines were 11 ins. and 20 ins. diameter, and 15-in. stroke. Each engine had two flywheels 78⅝ × 16⅝ ins., and each had 2,445 lbs. of metal in the rim, both cylinders had piston valves controlled by shaft governor.

Dynamos.—The dynamos were Westinghouse 4-pole railway generators rated at 111.9 K-W., and were designed for a speed of 625 revs. per minute.

Cars.—The three cars were 16 ft. long and weighed 14,500 lbs. Each was equipped with two 30-HP. Westinghouse motors.

Road.—This was laid with 52 and 56-lb. T-rails on cross-ties and ballasted with sand, for part of the distance and with stone the remainder.

Speed of Engine.—The revolution counter showed 238 revolutions as the average per minute for an eight minute test when the engine ran free with the dynamo belt off. It showed the same when running the dynamos with main circuit open. It showed 234.3 revolutions as the average of a six-hours' run during regular work, a reduction of 1.58% compared with its speed when running empty.

By the tachometer 239 revolutions was the maximum registered with the engine running with only a friction load (14.3 I. HP.). The same instrument recorded 227 revolutions with the dynamo generating 180 amperes and the engine developing 165 I. HP. During the regular run the tachometer showed a maximum of 237 revolutions, a minimum of 233 revolutions and an average of 234.5 revolutions, or the variation was 1.7% of the total revolutions.

Speed and Mileage of Cars.—The round trip of 21 miles was made in 90 minutes, which included two minute stops at each end and stops at three railway crossings. The speed, including the stops, was 14 miles per hour; excluding the stops, 15.38 miles per hour. During the test, lasting 17⅓ hours, two cars made 11 round trips and one car made 10 round trips, or a total of 703.5 car miles, and a total of 50.25 car hours.

The following tables show the important results of the test:

Economy Test.

| | |
|---|---|
| Average HP. developed in engine (indicator cards taken at 5-min. intervals) | 70.1 I. HP. |
| Average HP. delivered by dynamo (readings taken at 10-sec. intervals) | 45. E. HP. |
| Net ave. boiler pressure (half-hour readings) | 111.8 lbs. |
| Average vacuum (half-hour readings) | 25.2 ins. |
| Average steam used by engine per hour | 1,721.1 lbs. |
| Average steam used by engine per HP. per hour | 24.55 " |
| Steam used by fuel oil jet per hour | 291.5 " |
| Percentage of steam used by fuel oil jet | 14.5% |
| Fuel oil used per hour for engine | 20.25 gal. 133 lbs. |
| Fuel oil used per HP. per hour for engine, 0.29 gal. | 1.9 " |
| Additional fuel oil which would be required to maintain oil jet for one hour | 3.43 gal. 22.58 " |
| Average temperature of water flowing from air pump | 91.8° F. |
| Average temperature of feed-water entering boiler | 126.6° F. |
| Rise of temp. of feed-water due to heater | 34.8° F. |
| Percentage of fuel saved by heater | 3.06% |
| Water evaporated from 126.6° F. into steam at 112 lbs. pressure per gallon of fuel oil | 84.81 lbs. |
| Ditto per pound of oil | 12.9 " |
| Area of steam outlet of atomizer | 0.07 sq. in. |

It will be noted that 14.5% of the total steam generated was used by the fuel oil atomizer. The atomizer was not properly proportioned for the work, and did not receive enough air. The flame was red and evidently not economical. The atomizer and furnace have since been rearranged with much better results.

Distribution of Power Used.

| | |
|---|---|
| Power consumed by friction of engine, air-pump and boiler feed-pump, with main belt off | 9.22 I. HP. |
| Friction of engine, air and feed-pumps, and dynamo, with brushes off | 11.34 " " |
| Friction of dynamo and belt | 2.12 " " |
| Power consumed by engine, air and feed-pumps and dynamo, with brushes on and main circuit open | 14.34 " " |
| Power required to charge fields of dynamo | 3.00 " " |
| Rated capacity of engine | 150 " " |
| Rated capacity of dynamo | 150 E.HP. |
| Percentage of engine capacity required by friction of engine, air, and feed-pumps $\frac{9.22}{150}$ | = 6.15% |
| Maximum power developed by engine, as shown by indicator cards, during economy test | 141.4 I. HP. |

* Condensed from a paper presented at the Montreal meeting of the American Society of Mechanical Engineers.

| | |
|---|---|
| Minimum power developed by engine, as shown by indicator cards, during economy test | 21.27 I. HP. |
| Average power developed by engine, as shown by 208 sets of indicator cards, during economy test | 70.1 " " |
| Maximum volts developed by dynamo | 520 volts. |
| Minimum " " " " | 480 " |
| Average " " " " | 501 " |
| Maximum amperes developed by dynamo | 200 amperes. |
| Minimum " " " " | 4.7 " |
| Average " " " " | 67 " |
| Average watts delivered by dynamo | 33,567 watts. |
| Average electrical HP. delivered by dynamo | 45 E. HP. |
| Average indicated HP. delivered to pulley of dynamo, estimating friction of armature shaft, to be the same as friction of belt | 59.8 I. HP. |
| Average commercial efficiency of dynamo $\frac{45}{59.8} = 75.25\%$ | |
| Average number of cars in use during test | 2.89 cars. |
| Number of passengers on cars during 17½ hours | 1,014 |
| Number of single trips of cars | 64 |
| Average number of passengers on cars per single trip | 15.2 |
| Average number of passengers on cars at any one time (estimated) | 8 |
| Weight of 10 persons at 140 lbs. each | 1,400 lbs. |
| Weight of cars | 14,500 " |
| Total weight of cars and persons | 15,900 " |
| Average weight in motion | 45,950 " |
| Average electrical HP. per 1,000 lbs. of weight moved | 0.98 E. HP. |
| Average HP. developed by engine per 1,000 lbs. of weight moved | 1.52 I. HP. |
| Average watts required per car | 11,615 watts. |
| Average electrical HP. per car | 15.54 E. HP. |
| Average HP. developed in engine per car | 24.25 I. " |
| Average watts delivered by dynamo per HP. developed in engine | 478.8 watts. |
| Average watts delivered by dynamo per HP. delivered to belt of dynamo | 557.3 " |

Although the engine was worked condensing, the high-pressure cylinder did a good share of the work even on the lightest loads, and the receiver pressure did not vary greatly either during a single revolution or during a change of load of from 21 HP. to 101.8 HP. While the load changed 485%, the average receiver pressure only changed 167%, and even when the engine ran with the belt off and developed 9.2 HP., there was no negative work in either end of either cylinder. These results, which I believe to be highly important, both for economy and close regulation, are due to the valves of both cylinders being controlled by the governor.

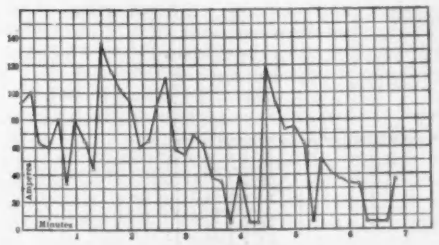


Diagram Showing Amperes of Current Measured at 10-Second Intervals.

The variations in load in a plant of this kind are not only extreme but rapid. The accompanying cut shows a sample of the ampere readings during about seven minutes, at intervals of ten seconds. The variation is from 5 to 134 amperes, and in one interval of ten seconds the load increased 115 amperes, which equals 120 I. HP. During the regular operation of the plant and with these extreme variations in load, the needle of the tachometer never left the space enclosed by the 230 and 240 revolution marks.

## LONG-TAPE BASE-MEASURING APPARATUS.

In our issue of Feb. 1, 1894, was given an abstract of a paper describing the method of using long steel tapes in measuring base lines by the U. S. Coast and Geodetic Survey. The publication of this abstract has called to our attention the fact that long steel tapes had been previously employed for this purpose by the U. S. engineers engaged on the Mississippi River surveys, and we herewith present an abstract of a report upon this subject, as made by U. S. Assistant Engineer H. M. Marshall to Capt. J. H. Willard, Corps of Engineers U. S. A. The several dates and the degree of accuracy attained in several base lines measured are set forth in a letter of Mr. Marshall published in our issue of Feb. 15.

The apparatus here described was developed by Mr. Marshall, and its essential feature is the use of two tapes, side by side, one made of steel and the other of brass. Each tape was about 350 ft. long, ⅛ in. wide and 64-100 in. thick and the two were stretched equally by means of weights sliding on balanced beams. This use of the two metals was intended to overcome what was considered the main source of error in long-tape measurements, namely, the uncertain temperature corrections. The difference in length, due to difference in rate of expansion, measured the temperature of the tapes themselves; and the same thing on a different plan had been put in practice by Professor Jaderin, of Stockholm.

The tapes, each about 100 m. long, were rolled under a special order by J. A. Gowdy & Son, of Providence, R. I., and tests made at the Watertown arsenal developed the following characteristics:

Tests of Brass and Steel Tapes.

| Characteristics. | Brass tape. | Steel tape |
|---|---|---|
| Sectional dimensions (in.) | 0.128 × 0.0128 | 0.129 × 0.0130 |
| Sectional area (sq. in.) | 0.0016 | 0.0017 |
| Ratio of elong. (load, 40 lbs.) | 0.0008 | 0.0006 |
| Ratio of set | 0.0001 | 0.0001 |
| Tens. strength (lbs. per sq. in.) | 60,000 | 227,650 |

That they might be subject to the same temperature, they were stretched side by side and measurements made simultaneously. These steel tapes were graduated by the U. S. Coast and Geodetic Survey, the steel being copper plated over the space to be graduated. The steel tape was also standardized before graduation by using paper scales glued to the tape, and the length of the brass tape was found at several varying temperatures. Graduation extended both ways from the standard marks near the end over a space of two decimeters divided to millimeters. The numbers ran both ways from the zeros. These tapes were kept and transported on 15-in. reels.

The instruments for applying and measuring tensions are an adaptation of those used by U. S. Assistant Engineer O. B. Wheeler, but the method and means of marking the ends of the tape length are believed to be original with Mr. Marshall.

The apparatus used consisted of four tension frames, two balance beams, two verniers, tape clamps, tape chains and tape supports. This apparatus is shown in the accompanying cuts, taken from the report of Mr. Marshall. The tension frame (Fig. 1) consists of a clamp and frame of brass. The clamp has two arms above it, to which is screwed the three-sided rectangular frame. A screw working in one end moves the brass block, which is guided by flanges sliding in grooves in the sides of the frame. The screw is attached to the block, as shown in section, by a collar, so that it will not be disengaged by turning. Two small hooks are screwed in the front of the block to attach the tape chains when the frame is used at rear end of the tapes. A triangular space is cut out of the block, and in the sides adjacent are cut seats for the knife edges of the balance beam to rest in.

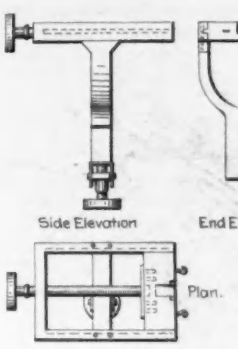
The balance beam, shown in side view and projection (Fig. 2), is brass and has steel knife edges on which it rests, and knife edges about which turn the stirrups of the steel hook to which is attached the front end of the tape chain. On the top of the upper short arm of the beam is a small level vial in a case attached by adjusting screws to the beam. On the end of this short arm is a screw on which works a counterpoise to balance the beam without the pea. The long arm of the beam is divided so that the mark 5, which is the same distance from the knife edges on which the beam rests, as are the knife edges about which the stirrups turn, shall indicate a tension equal to the weight of the pea, and twice that distance a tension twice the weight of the pea. The pea weighs 5 lbs. and its mass is so distributed that the center of gravity lies in a vertical plane perpendicular to the face through the index point.

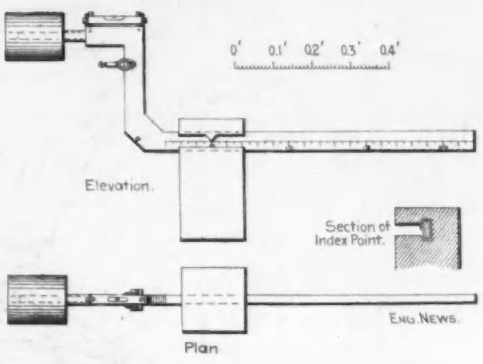
The vernier (Fig. 3) consists of a clamp and frame similar to the frame of the tension balance, with the addition of a hollow cast block. This block is attached to a slow motion screw for raising it under the tapes after they are stretched, and is guided by flanges sliding in grooves in two vertical arms fastened to the other brass block, which is capable of transverse motion. The hollow cast block has on its upper face two metal graduated strips laid flat, with stops near the ends to hold the tapes close to the vernier. Verniers are marked 0 at the middle and are set exactly opposite. The graduation extends 9 millimeters each way from the zeros, and is divided into ten parts, so that the reading is to a tenth of a millimeter. In the grooves of the vertical arms slips a flange fastened to a bar carrying folding compass sights, which enables the vernier zeros to be brought at right angles to the base line. In the center of the head of the vertical slow-motion screw is a small hook for attaching a plumb bob.

The four clamps are each 1 in. long and are so made as to permit the tape to be slipped in on one side and held by a bearing plate, pressed by two milled-head set screws, giving a straight pull in alining and having a swivel hook at one end. The four tape chains are each about one meter long and are made of No. 12 steel wire links, each about ½ in. long. The nine suspension supports are made of No. 12 wire, shaped like the two sides of an isosceles triangle, with a height of 3 ins. and a base of 2 ins., with a ring turned at the apex and having an extended hook with flat bottom at the end of each leg. The support is flat; that is, the wire is all in the same plane.

The method of setting and operating the tapes is described as follows in Mr. Marshall's report, the line being previously cleared:

Six stakes, 3 ft. long, 2 ins. square; three pieces of plank, 1¼ ins. thick, 2 ins. wide and 2 ft. long; nine




FIGS. 1 AND 2.
TENSION BALANCE FOR BASE MEASURING TAPES.

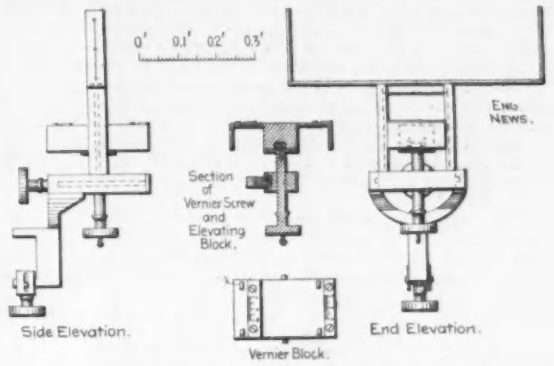



FIG .3.—DETAILS OF VERNIER FOR BRASS AND STEEL MEASURING TAPES.

stakes, 2 ins. square and of lengths somewhat to compensate irregularities of the ground line, are distributed over each tape length; stakes are all lined by transit. Beginning at the rear end of the tape, two stakes are driven about 3 ft. back of the initial point of the base. On top is nailed a piece of the plank which makes a table to clamp tension frames to, one on each side. Two stakes are next driven level with the first two stakes, but 2 ins. to the right of the line, about 9 ins. forward and back of the initial point of the base. On these is nailed a plank for clamping vernier (see Fig. 4). Along the line, at intervals of one-tenth the tape length, stakes are set, with nails driven in the rear face of the stake, the heads being a little lower than the points; the nails are kept about level by the eye. At the front end of tape stakes are set for tables, as at the rear end, and in addition a table is set on line about 3 ft. forward of the end of the tape and 2½ ins. lower than the vernier table, for clamping the tension frames of the balance beams. Elevations are taken on the vernier and heads of nails with a level.

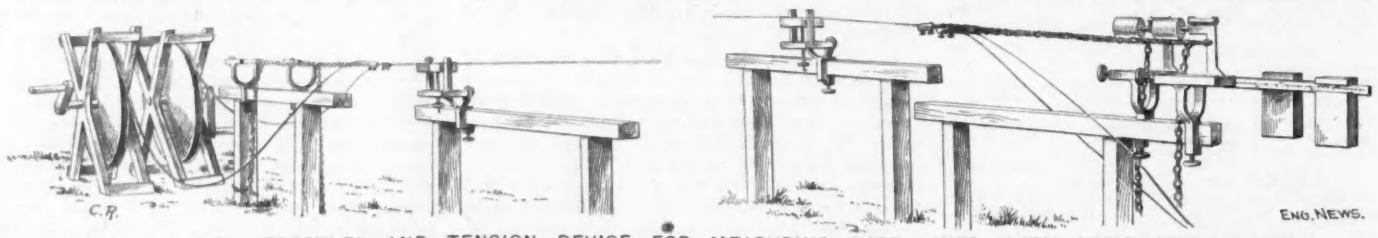



FIG. 4.—REEL, TRESTLES AND TENSION DEVICE FOR MEASURING BASE LINES WITH LONG STEEL TAPES.

An observer, a recorder and one assistant at each end of the tapes, and nine men at intervals of one-tenth the tape length, place the tapes one on each side of the stakes supported by the suspension hooks hung on the nails. The assistants adjust the clamps near the tape ends and hook on the chains, clamp the tension frames to the straining tables, one on each side, and by means of the chains attach the rear ends of the tapes to the frames and the front ends to the hooks on the balance beams, rest the beams on the knife edges, and slip the pea on the beam and set it to the required pull; adjust the tension by the slow-motion screws of the frames till the beam is balanced and the level centered. The observers clamp a vernier to the table at each end of the tape.

At the rear it is set by the plumb over the initial point, alining by the compass sights, raised under the tapes by the elevating screws, and adjusted by the transverse screws till the tapes lie easily alongside the verniers. With pocket rule rear observer measures height of vernier above table. Observer at front end cries, "Ready! read steel!" Both read the distance in millimeters on the tape from its zero to vernier zero and tenths of a millimeter on vernier and have recorders make entry. Observer at rear end replies, "Read!" Observer at front end cries, "Read brass!" Both read as before and observer at rear end replies, "Read!" Front observer cries, "Shift tapes forward!" and assistants by means of the slow-motion screws move the tapes bodily several centimeters along their length, the men at intermediate stakes being careful to keep supporting hooks swing free by tapping them lightly. Front observer again cries, "Ready!" and the programme is repeated. The tapes are then shifted back beyond the initial reading and readings taken again. In the reduction the mean of all the readings for each tape is taken to obtain the distance between vernier zeros.

For the next tape length the front observer calls out, "Make ready!" assistant at front end lifts balance beams and slips off the peas, both assistants unhook chains and unclamp tension frames, men along the line lift tapes and suspension hooks, rear observer unclamps vernier and sends it forward by his recorder to front recorder, front observer leaves his vernier clamped and calls, "Forward, march!" The remaining part of the base is measured in the same way, except that after moving forward the rear observer does not change the position of his vernier, unless he may have to alter the elevation by the elevating screw. In reading and recording forward is counted from tape zero in the direction the base is measured. At the front end of the tape forward readings are plus and backward readings are minus. At the rear end forward readings are minus and backward readings are plus. The check on readings in the field is that the first reading at front end minus second reading at front end must be nearly equal (within half a millimeter) the first reading at rear end minus second reading at rear end, and must be of opposite sign; in other words, after the tapes are shifted the shift must show the same amount and of opposite sign at the two ends of the tape, otherwise the readings were wrong.

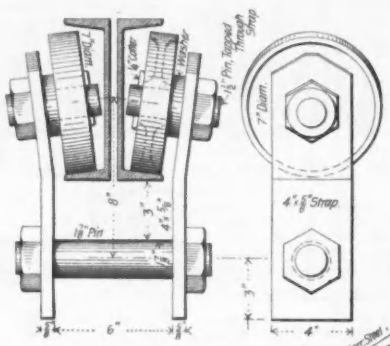
For the general formulas developed in determining absolute length of steel tape, bases and temperature from tapes and side by side, and for the full detail of the results, the reader is referred to Appendix V. of the Annual Report of the Chief of Engineers for 1893, p. 1926 et seq.

## NEW BUILDINGS FOR THE PITTSBURG REDUCTION CO. AT NIAGARA FALLS.

One of the first manufacturing firms to make use of electricity from the Niagara Power Co.'s great dynamos will be the Pittsburg Reduction Co., which will employ a current of 150 volts in the reduction of aluminum at its new plant at Niagara Falls. The Hall process of producing aluminum by electrolysis, which the Pittsburg Reduction Co. controls and uses, was fully described in the Engineering News of Nov. 8, 1890, and further articles on the manufacture and properties of the metal have been published in the issues of Feb. 22 and March 1, 1890, and Feb. 8, 1894. Some of the principal features of the new buildings which the company is now erecting on the land of the Niagara Power Co. are shown in the accompanying cuts.

The plant will comprise a main building for reduction, 193 ft. 10½ ins., × 85 ft. c. to c. of posts; a manipulating building 70 ft. × 75 ft., and a stock building 70 ft. × 100 ft. The main building will be 26 ft. high on the posts and the other buildings 21 ft. high on the posts. Fig. 1 shows the construction and dimensions of one of the main roof trusses for the reduction building, and Fig. 2 shows a partial side elevation of the iron work and window framing. Fig. 3 is a drawing of one of the trolleys to run on the bottom chord of the roof trusses and carry a chain hoist. The following is a brief abstract of the specifications:

The iron buildings are to be of rigid framework of metal throughout, including steel purlins and girts, with riveted connections. Each transverse bent is to be made up of a steel roof truss, supported at both ends by steel columns; anchored to the bolts extending up through masonry piers and cast iron pedestals. The bents are to be made rigid by transverse bracing, consisting of knee braces in the intermediate bents and vertical braces in the end bents between columns. On the sides of the buildings, vertical bracing is to be supplied between the columns, and lateral bracing in the planes of both top and bottom chords of the roof trusses. Each of the buildings is to be well braced to resist the action of the horizontal forces, using both



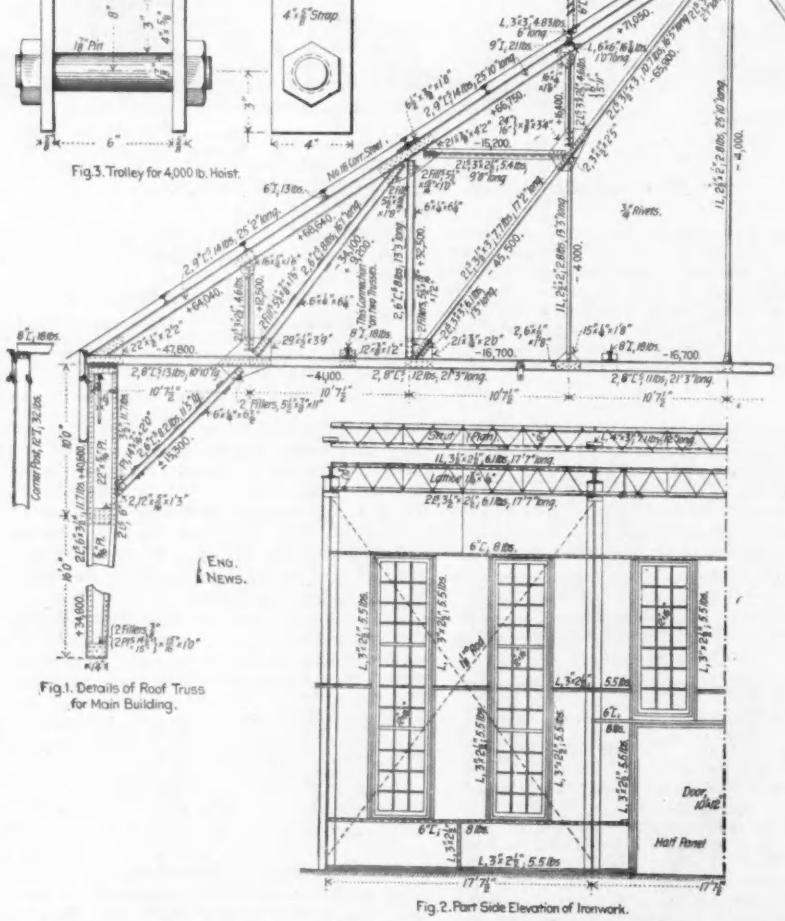




Fig. 1. Details of Roof Truss for Main Building.



Fig. 2. Part Side Elevation of Ironwork.

DETAILS OF IRONWORK FOR MAIN BUILDING, PITTSBURG REDUCTION CO.'S PLANT, NIAGARA FALLS, N. Y.

longitudinal and transverse bracing in vertical planes and lateral bracing in horizontal planes.

The panel lengths are to be 17 ft. 7½ ins. in the reduction building, and 25 ft. each in the other buildings. In the main building, there will be eleven roof trusses and 22 main columns. There will be 17 lines of purlins extending over one panel length at each end of the building and 15 lines of purlins extending over the seven intermediate panels, and five lines of purlins in the ventilator of the building. Over the hip portions at each end of the buildings there will be four lines of purlins. In reckoning this number of purlins, the longitudinal struts at the eaves are reckoned as a line of purlins. There will also be two lines of panel girts extending around the entire building and just above and below the windows with the exception of where the door spaces intervene; also lines of studding extending either side of windows and doors, between these lines of girts, and two other lines of girts, one in intervening spaces between the windows and extending entirely around the building, and the other just over the foundation walls.

The corrugated iron in the sides of the building is divided into four lengths, and is to be 2½ ins. to 3 ins. c. to c. of corrugations, which are to be about ¾ in. high. The distance between purlins is 6 ft. 5 ins., and the iron is to be fastened to the purlins and girts on the sides of the buildings, by means of hoop iron clips, spaced not more than 12½ ins. apart, the clips passing entirely around the purlins and being riveted on both ends of the corrugated iron. The bottom chords of the roof trusses of each of the buildings, with the exception of the trusses at the extreme ends, are to be fitted with light carriages, which are to run upon the bottom chords of the trusses as runways. These carriages shall be capable of having a chain hoist attached to them lifting a maximum of 4,000 lbs. weight.

The construction of the two smaller buildings corresponds in its main features to that of the main building and needs no further description. Steel is to be used for everything except welded rods. The steel is to have an ultimate strength of from 54,000 to 68,000 lbs., an elastic limit of at least one-half the tensile strength, an elongation of 23% in 8 ins., and a reduction of area of 45%. The wrought iron, to be used in the structure only in welded rods, is to have a tensile strength of at least 48,000 lbs. per sq. in., an elastic limit of at least 26,000 lbs. per sq. in., and an elongation of at least 15% in 8 ins. The fracture under tensile and nick-bending tests is to be fibrous.

The contract for the iron work has been let to the Penn Bridge Co. for $17,900. There were nine bidders in all, the bids ranging from $24,000 to $17,900.

## A TEST OF THE POHLE AIR-LIFT PUMP AT DE KALB, ILL.

By L. B. Merriam.

The city of De Kalb, having sunk an artesian well for an additional water supply, determined to make a test of the Pohle air lift for raising the water to the surface. At the outset of the test the surface of the water stood 68 ft. below the center of the discharge pipe. A casing, consisting of 304 ft. of 6-in. wrought iron pipe, with screw couplings, was put down and a water T screwed on. Inside of the 6-in. pipe was put a 2½-in. air pipe, the bottom of which was reduced to a diameter of 1¼ ins. and a short nipple and a return bend put on. In the open end of the return bend a nipple of 1¼-in. pipe was screwed for a nozzle, all as shown in Fig. 1. The rest of the plant consisted of a small Rand compressor, with steam cylinder 12 ins. and air cylinder 14 ins. in diameter and a stroke of 16 ins. Steam was supplied by three threshing machine boilers and there was a suitable air receiver. Several depths of the nozzle were tried, the most satisfactory results being obtained at a depth of 256 ft. below the center of the discharge pipe. This depth seemed to correspond very closely with the capacity of the compressor.

Two days were spent in preliminary tests, in which it was demonstrated that with more boiler and compressor capacity more water could be raised with the nozzle lower.

Having decided that the best conditions were attained, a careful test of efficiency was made. The plant had been running smoothly for about 20 minutes when the test began. Indicators were put on the steam cylinders and the following results were obtained:

| | |
|---|---|
| Distance from surface of water to center of discharge pipe, ft. | 133 |
| Hydraulic lift, ft., including friction (about) | 143 |
| Distance from surface of water to nozzle, ft. | 123 |
| Receiver pressure above atmosphere, lbs. per sq. in. | 53 |
| Hydrostatic pressure at nozzle, lbs. per sq. in. | 53.3 |
| Mean effective pressure, steam cylinder, head end, lbs. per sq. in. | 41.8 |
| Mean effective pressure, steam cylinder, crank end, lbs. per sq. in. | 45.2 |
| Area piston head, head end, sq. ins. | 110 |
| " " " crank " " " | 113 |
| Strokes per minute | 109 |
| Horse power developed | 42.74 |
| Water pumped, per minute, gallons | 207 |
| Hydraulic work, HP. | 7.47 |
| Efficiency, $\frac{\text{Hydraulic work}}{\text{Power developed}}$, per cent. | 17.48 |
| Theoretical amount of air used, lbs | 23.84 |

The amount of air was obtained by the assumption that the cylinder filled each stroke. The water was measured in a horizontal rectangular weir of good construction, 10 ins. wide, with side contractions, computed with the formula: Quantity in gallons per minute $= 3.3\ (1-0.2H)\ H^{\frac{3}{2}} \times 60 \times 7.48$.

The 23.84 lbs. of air per minute used would, under theoretical conditions corresponding to those shown in Fig. 2, have an average volume of 1,034 gallons, which, adding the volume of water raised, 207 gallons, gives a total of 1,241 gallons, weighing 1,752.3 lbs. On the basis of 8.35 lbs. per gallon for the water, this gives a specific gravity of $\frac{1,752.3}{1,241 \times 8.35} = 0.13$ for the entire mass, equivalent to a pressure of $0.13 \times 0.433 \times 256 = 14.4$ lbs. per sq. in. at the nozzle of the air pipe.

The pressure due to static head, however, is 123 × 0.433 = 53.3 lbs. per sq. in. This shows that the efficiency of the apparatus used was very low in comparison with its possibilities, which was due to three causes:

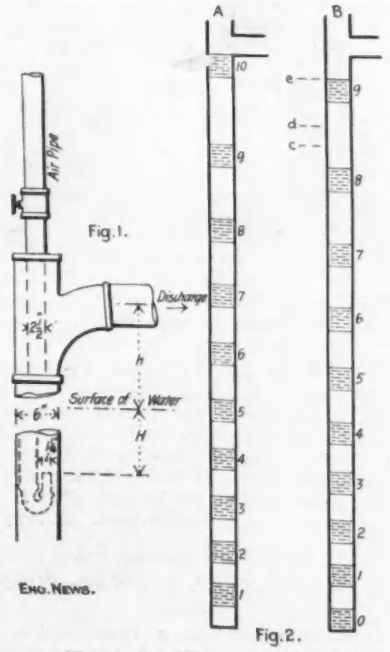



Fig. 2.

Diagrams Illustrating Theory of Pohle Air Lift Pump.

(1) The apparatus is too large for the amount of water to be obtained from the well without lowering the water in the well. (2) The roughness of the inside of the discharge pipe and outside of the air pipe. (3) The very poor design in the vicinity of the nozzle of the air pipe.

With perfect apparatus and unlimited supply of water, it seems to me that the quantity of water pumped should be such that the pressure at the nozzle due to the weight of the column in the discharge pipe, plus the resistance due to friction and velocity, would be equal to the pressure due to the static head, and could be computed from the following formula:

$$S\,\frac{H}{H + h + H_f + H_v} = Sg,$$

in which,

H = Submersion. See Fig. 1.

h = Distance from surface of water to center of discharge pipe. Fig. 1.

$H_f$ = Friction head.

$H_v$ = Velocity head.

Sg = Specific gravity of the rising column. Fig. 2.

S = A factor to be deduced from experiment with the best apparatus and represents the slip of water past the air bubbles.

If this formula be applied to the De Kalb test it will give a marked increase of efficiency $\frac{123}{123 + 133 + 10} = 0.462$, as the specific gravity of the mass, instead of 0.13 as, above.

The law of efflux of air in this device should be determined; but in order to get at it some very careful records of pressures both of air and water at the nozzle must be obtained. Until this law is determined there should be some device to throttle the air at the nozzle, so as to be able to decrease the flow without decreasing the pressure. The theoretical working of this air lift is illustrated in Fig. 2. The first part, A, shows Portion 10 just up to the discharge pipe. The air pressure in the receiver is just completing its portion of the work. As soon as the water, Portion 10, begins to flow out, the water pressure will begin to act on account of the decrease of pressure from the column. The second part of the figure, B, shows the work of water pressure just finished and the receiver pressure about to act. Portion 9 shows the effect of expansion of air due to its lessened load. The dotted line, e, shows where the top of Portion 9 was before the water pressure began to act, d, the point to which the water pressure would move it and, e, its actual position. That is, it was moved through the space e-d by static pressure, and through d-e by the expansive energy of the air below it.

## THE MUSHKAF-BOLAN STATE RAILWAY, INDIA.

The situation of the Indian railway system in regard to its availability for military purposes in case of a threatened invasion along the northern frontier has been more than once discussed in our columns, and we publish this week an article contributed by an engineer on the Indian State Railways, describing the Mushkaf-Bolan Railway, which extends through Beluchistan to Quetta, and points towards a future terminus at Candahar, in Afghanistan. The position of this line and its relation to the frontier railways was indicated on a map on the inset sheet of our issue of July 20, 1893, in which issue some of the questions relating to the frontier railways were presented, while the Bolan Railway has also been referred to in our issues of March 23, April 20 and Nov. 9, 1893. The article sent us is as follows:

Quetta is the old capital of Beluchistan and is now the largest military cantonment on the northwest frontier of India. The Pishin plateau, on which this town has been built, rises over 5,000 ft. above the level of the sea, and many of the high peaks round it are from 4,000 to 6,000 ft. higher. Within the last ten years Quetta has been developed into a first-class military post, and many of the foremost military authorities seem to think that the Quetta defences will preserve the Indian empire against the attack of any northern invader. The art of modern war, however, demands for success unbroken communication with the base, and it is that necessity which led to the construction of the Mushkaf-Bolan Ry., after having been shelved for about five years. Quetta is now connected with India by the Sind Pishin Ry., which, though a bold undertaking, has never been a success, and its usefulness as an aid in a campaign is utterly destroyed by the persistent slips at Mud Gorge (Eng. News, March 23 and April 20, 1893), which, though instructive to the engineers, are certainly destructive to continuity of carriage between India and the Pishin plateau.

Such being the case, a project for an absolutely safe line of railway was demanded by the military authorities, and the Mushkaf-Bolan Ry., which is now approaching completion, is expected to fulfil that requirement. It might now have been on the eve of opening for traffic but for the scattering of scanty funds over a number of public works, instead of concentrating them on the most important, since the financial position of the government of India has become so involved, owing to the depressed state of its silver currency. A broad policy in dealing with the funds for public works in India

will, however, never be initiated so long as the portfolio of the Public Works Minister continues to be entrusted to either an ex-magistrate or an ex-soldier, waiting for higher appointments, and having little or no experience or interest in matters relating to public works.

The new line leaves the Northwestern Ry. at the old frontier station of Sibi and runs due northwest for about 65 miles, when it strikes the southern end of the Pishin plateau, along which a line of rails has already been laid into Quetta. The Sibi station is 430 ft. above sea level, and the summit is 5,900 ft. above the sea, the total rise being nearly 5,500 ft. in about 60 miles. The line is on the Indian standard gage of 5 ft. 6 ins., and the system of "bunching" the steepest grades has been developed with special consideration for convenience of working with auxiliary engines, an arrangement which will enable the traffic to be carried forward as on a ruling grade of 1 in 55, or 1.82%. Another feature of construction is the refusal to repeat the errors of the alinement of the Sind Pishin Ry., which skirts the spurs of the shale and disintegrated sandstone hills, while on this new railway such spurs have been tunneled, thus avoiding any disturbance of their slopes. Although there is not so bold a piece of engineering as the "Chuppar Rift," there is, on the other hand, no sliding "Mud Gorge" on this new line, care having been taken to avoid running unnecessarily into engineering difficulties merely for the sake of display in trying to overcome them, a feature which has been somewhat evident in Indian railway construction.

The country traversed by the Mushkaf-Bolan Ry. may be divided into three well-defined sections, having distinctly different features. The first 30 miles are very rough and cut through numerous high rocky spurs, requiring 13 tunnels and a number of large bridges, the ruling gradient being 1 in 55. The next 20 miles are over an open, stony, waterless country, along the base of steep-sloping limestone hills, and requiring an abnormal number of bridges to pass the storm waters that occasionally pour down the numerous gorges which deeply score the hillsides, and, if checked, would simply overwhelm the lines with masses of rocks and boulders.

The upper 16 miles are in a wild country of high, bare limestone hills, through which the Bolan River has cut a deep, tortuous channel. Some idea of the difficulty of this section as an engineering achievement may be obtained from the fact that the railway has to cross the Bolan torrent nine times in four miles, which necessitated the most careful individual designing to adapt the bridges to the many varied conditions of construction. On the old Bolan line the bridges were very carelessly placed, so that the flood water often impinged broadside on to the piers, which were actually battered to pieces by the boulders dashed against them. In the Mushkaf-Bolan bridges this damage has been obviated by constructing all piers parallel to the axis of the river, however much skew that may involve, and some of the piers have their cut-waters built something like the piers on Canadian railway bridges for parting ice floes. All the masonry is laid in Portland cement mortar.

There are five tunnels on this upper length and the ruling gradient is 1 in 25, or 4%. The tunneling through the treacherous shales, with soft sandstones and disintegrated limestones, has been very arduous, and the most of the 10,000 lin. ft. has been done with native miners. The Panir tunnel (Eng. News, Nov. 9, 1893), 3,000 ft. long, is the longest tunnel, and is the only one at which compressed air machinery was used; and in order to work both faces simultaneously, the compressed air has been carried in iron pipes over the summit of the hill, which is 1,000 ft. above the tunnel. The average progress of the headings worked out to 13 lin. ft. per day.

The tunnels and the masonry of all the bridges are built for double track. All tunnels on tangents are 29 ft. wide, and some had to be extensively timbered, the general principle for conducting these works being that nothing is so expensive in tunneling as a cave-in.

The bridge girders are heavy and they have been designed to carry the track through on ballast laid on corrugated iron flooring, as was first introduced in India on the Delhi-Kalka Ry.

On the "bunched" steep grades the track is of steel T-rails, weighing 100 lbs. per yd., laid on steel trough ties, this being the heaviest section of rail as yet introduced in India. The ties are of the Indian State Railway pattern.

A temporary track is laid along the upper 30 miles of this line, over which trains work regularly for carriage of material to the sites of work; and at one place there is a "zigzag," or a switchback, on the ruling grade of 1 in 25, rising 70 ft. in a horizontal distance of less than half a mile. At the Panir tunnel there is a temporary rope incline on the three-rail system (that is, with the center rail common to both tracks), with passing places in the middle, the slope throughout being 2½ to 1, or 40%.

The country through which this new line passes is practically waterless and is totally uninhabited. Water has had to be brought in wrought iron pipes from springs long distances apart, and is distributed for many miles along the line in smaller pipes for masonry and drinking purposes. The heat in the lower lengths during the summer is terrible, while in the upper lengths the cold is very severe during the winter, when work is often stopped by severe blizzards. The whole of the labor has had to be imported.

To construct a railway on the 5 ft. 6 ins. gage through such a country, under these conditions, is indeed an engineering achievement, and the government of India was fortunate to be able to entrust this heavy work to so experienced an engineer as Mr. James Ramsay, M. Inst. C. E., as Engineer in Chief. This gentleman, however, under the rigid rules of the Indian Public Works Department, must be placed on the retired list just before his work is completed. Mr. Ramsay brought a ripe experience to the frontier railways in 1885, since which time he has been able to profit by the negative lessons taught on the Sind Pishin Ry., the improvement of which railway was entrusted to and carried out by him, after it was handed over to the Northwestern Railway to operate.

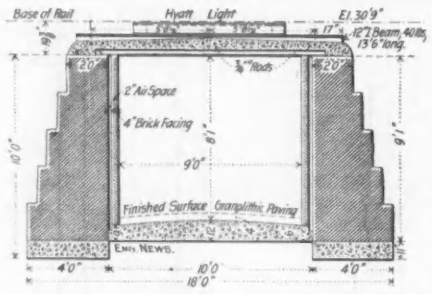



Fig. 1.—Cross Section of Franklin St. Subway, Boston, Mass. Wm. Jackson, City Engineer.

## THE FRANKLIN ST. SUBWAY, BOSTON, MASS.

We illustrate herewith a cross section and roof details for a subway for foot travel which is being constructed underneath the tracks of the Boston & Albany R. R. at Franklin St., Boston, Mass. This subway is 148 ft. 3 ins. long from bulkhead to bulkhead and 9 ft. wide inside in the clear, and is entered by stairways at the ends.

Fig. 1 shows a cross section of the subway. The side walls are of rubble masonry, laid in Portland cement, and rest on foundations of concrete. Inside the rubble walls are brick walls 4 ins. thick, separated from them by a 2-in. air space. This brick facing is bonded to the side walls every 2½ ft. by cross walls, forming continuous ties from top to bottom. The floor is of concrete, 12 ins. thick at the crowned center, and is covered with 4 ins. of granolithic paving. The roof carrying the railway tracks is made of 12-in., 40-lb., I-beams, 13 ft. 6 ins. long, between which are sprung concrete arches, resting on curved steel roof plates ⅜ in. thick, as shown in Fig. 2. Underneath each rail is a girder, made up of two I-beams, connected at the top flanges by a 11½ × ⅜-in. plate, secured by ¾-in. rivets of about 6 ins. pitch. Between each of the eight tracks is a metal skylight frame for a Hyatt light, as shown in the illustration, Fig. 2. The whole system of beams is bound together from end to end of the subway by three ¾-in. rods. The following are the specifications for materials and workmanship:

All stone used in the work to be of good quality, and free from structural defects, and the granite coping must be equal in quality to the best Milford granite. The bricks are to be of the best quality, water struck, burned hard entirely through, regular and uniform in shape and size, and of compact texture. Bricks which, after being thoroughly dried and immersed in water for 24 hours, absorb more than 16% in volume of water may be rejected.

All the masonry is to be laid solid in cement mortar, made of one part of cement and two parts of sand. The concrete is to be made of one part of cement, two parts of sand, and five parts of sound or acceptable broken stones or pebbles; all parts by measure. The concrete shall be mixed in a manner satisfactory to the engineer, and after the materials are wet the work must proceed rapidly until the concrete is in place. Two kinds of cement will be used in the work; American hydraulic and Portland cement; and they must be made by manufacturers of established reputation, must be fresh and very finely ground, and put up in well-made casks. To insure its good quality, all the cement furnished by the contractor will be subject to inspection and rigorous tests, and if found of improper quality will be branded, and must be immediately removed from the works; the character of the tests to be determined by the engineer. The contractor shall, at all times, keep in store, at the site of the work, a sufficient quantity of the cement to allow ample time for the tests to be made without delay to the work of construction. The engineer shall be notified at once of each delivery of cement. All cement must be so stored as to keep it dry; and each cask as stored must be raised several inches above the ground, by blocking or otherwise.

The sand used in making mortar and concrete shall be coarse, clean and sharp, free from loam and pebbles. The broken stone or pebbles used for all concrete except that used in the arches between the beams must be clean and sound, and of varying sizes, none to be more than 2½ ins., and but very few less than ¼ in. in their greatest diameter, and must be free from clayey or other objectionable materials. The stone for the concrete of the arches must be broken, of acceptable quality, screened so that it will pass through 1½-in. meshes, and will not pass through ½-in. mesh. In measuring cement it shall be packed as received from the manufacturer; and in measuring sand it shall not be packed more closely than by throwing it into a barrel. Any mortar not used within three-fourths of an hour after mixing will be rejected. Mortar used for pointing is to be made of equal parts of Portland cement and fine, sharp sand. The steel plates and shapes are to be of soft steel.

The contract for the subway was let to Jones & Meehan, of Boston, Mass., June 9, and the work is to be completed by Aug. 15. The contract price was $9,200.

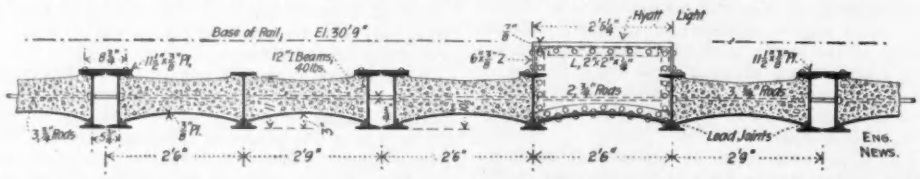



FIG. 2.—PART LONGITUDINAL SECTION OF ROOF, FRANKLIN ST. SUBWAY, BOSTON, MASS

## REMINISCENCES OF JAMES B. FRANCIS.

By Joseph P. Frizell, M. Am. Soc. C. E.

The memoirs of Mr. Francis, lately put forth by contemporary engineers, especially those by Mr. H. F. Mills and by Messrs. Fitzgerald, Freeman and Davis, have given the main facts in his professional career; all that could be gleaned from records or gathered from common report. Such facts are the outline and framework of a man's history. Painstaking efforts to collect and put them on record are worthy of all commendation. Nevertheless, such facts, however systematically catalogued and clearly set forth, give but a meager view of a man's personality. They are but the scattered bones of the mastodon, which must be laboriously collected and

brought together; but we must, in imagination, clothe them with flesh if we would form any just conception of how the creature lived, moved and had his being upon the earth.

If my own faculty of expression were equal to my means of observation, I might be able to add something of interest to the biography of this justly eminent man, having been his trusted and confidential assistant for many years, and having been associated with him in various professional affairs from time to time since the termination of that relation in 1867. I desire to do what I can at any rate to perpetuate his memory as a man and as an engineer.

My first employment in his service was in 1857, when he was about 42 years of age, in full intellectual and physical vigor, just after the publication of his work had raised him to universal recognition. He was then engaged in reconstructing the water-wheels of Lowell, substituting turbines for the cumbrous breast wheels previously in use. These turbines were made under the patents of U. A. Boyden, which had been purchased by the Proprietors of the Locks and Canals, as the corporation controlling the Lowell water-power is called. All these wheels ran upon vertical shafts and transmitted the power through bevel gears. The step bearings and gears were a fruitful source of trouble. One of Mr. Boyden's patents avoided the first of these difficulties by hanging the wheel from a suspension, becoming accessible for lubrication. Most of the turbines then running at Lowell were provided with this device. The remarkable adaptability of the horizontal turbine, whereby both gears and steps are avoided, had not then become apparent.

Massive solidity was the characteristic of all Mr. Francis' designs. Safety the first consideration. Novelty or brilliancy he never aimed at. He preferred to overstep the limit of security rather than fall short of it. He accordingly adopted in many cases dimensions that would now be considered excessive, but which, in the then existing state of the art, were judicious.

It was the expectation when the company purchased Mr. Boyden's inventions that turbines for Lowell and other places would thenceforth be designed by the company's engineer and made at the company's shop. The Boyden turbine was believed to be the culmination of human wisdom in water-wheels, destined to rule the market forevermore. The designing of turbines, however, soon ceased to be a scientific matter. It became a shop matter. Hundreds of inventors came forward with wheels of every pattern, embodying every conceit, fancy, illusion, whim and crochet that can find a lodging place in the perverse brain of man. They could be offered a great deal cheaper than the elaborate and permanent machine designed by Boyden and Francis, and what they lacked in merit was made up in assertion. Out of the vast waste of energy, ingenuity and capital incident to the placing of these hundreds of different forms of wheel upon the market, some half-dozen types, following the Darwinian law, have survived, and though it may be said confidently that no wheel has equaled the performance of the Boyden turbine, their cheapness and adaptability have held the market. Mr. Francis stood stoutly against these innovations till the tide waxed so high as to bear him away with it. Mr. Boyden contemptuously turned his back upon the whole business, and during the remainder of his life buried himself in scientific investigations.

In the latter part of the summer of 1857 I left the office one day feeling very strangely, went to bed and fell in to a sort of lethargy. Fifty days later I became conscious that something was wrong. I addressed some inquiries to the bystanders, being the first intelligent words they had heard from me. They informed me that I had been sick of a typhoid fever. Mr. Francis' attention and kindness to me during this emergency made an impression on my mind that will never be effaced.

I well remember, in early winter of 1859, Mr. Francis bringing in a young man and introducing him to me as my fellow assistant. I was just starting to make some measurements of a breast wheel, which was to be replaced by a turbine, and asked him to come with me. The wheel stopped running just as we entered the wheel-house. My companion stepped briskly in and suddenly executed a movement which astonished me. It was the first cold day of the season. Water thrown from the wheel had coated the surrounding space with ice. He slipped, fell, slid down a flight of stone steps and brought up against one of the great arms of the wheel. Had it been moving it would have crushed him like an egg, and the water-power of Lawrence would now have a different, though probably not a more efficient, engineer.

Mr. Francis was a very conservative man. Inventors generally derived little encouragement from him. He could recognize the merits of a new thing when they were clear and unmistakable, but the cheap ingenuity which attempts to improve existing arrangements without understanding them was lightly esteemed. A man once came to him with the request to examine a steam boiler fitted with some wonderful device for saving fuel. He looked it over carefully but did not seem inclined to make any comments. The man at length asked him what he thought of it. "It is a very good boiler," said he. "I see but one thing to prevent it from working well." "What is that?" said the inventor, visibly encouraged. "The device that you have applied to it," was the answer, to the great depression of inventive genius.

I once accompanied him to a machine shop to consult about the construction of a dynamometer. We conferred with the draftsman and gave him notes and directions for all the details of the machine. At the close of the interview he gave the draftsman a smart slap on the shoulder, saying: "And bear in mind that there is to be no sort of a gimcrack about it." His common answer to those who solicited his adoption of new things was: "I am one of those stupid old fellows who can't be turned from the beaten path. You will waste your time in talking with me."

It is no small tribute to his judgment that the methods of water measurement adopted by him at Lowell more than 50 years ago are still in use there, being probably the only mechanical art or process practiced in that city which has not undergone great and repeated changes since that time.

A quaint, dry humor pervaded his conversation, often so subtle as to be felt rather than apprehended. In company with several persons the conversation turned upon a gentleman who had been appointed to the management of a manufacturing company and of whose business capacity Mr. Francis did not entertain the highest opinion. It was stated that the gentleman had graduated at two different institutions of learning. Mr. F., apparently not heeding the conversation, said: "A singular story has just come into my head. In my father's library was a copy of "Joe Miller," which, when a boy, I became more familiar with than any book on the shelves. The story in it that occurred to me is of a man who boasted that he had graduated at two universities. 'That,' said a bystander, reminds me of a calf my father owned that sucked two cows.' The natural inquiry was, 'How did the calf turn out?' 'Oh, he became the biggest calf that ever was seen in those parts.'" His humor sometimes took a more practical shape. Once, in company with his overseer, Mr Cheney, he was examining a canal wall to see what repairs were required. A plank was laid projecting over the water and Mr. Francis volunteered to stand upon the land end and give the overseer an opportunity to make his observation from the other end. In this posture of affairs he noticed an acquaintance approaching, and, in his eagerness to shake hands, he stepped off the plank and plunged the overseer into the water. Of course he helped him out with many expressions of regret for his carelessness. Mr. Cheney, however, could never be persuaded that the ducking was wholly unpremeditated and privately expressed his intention of "getting even with the old gentleman" on the first opportunity. Whether the occasion ever presented itself I have not been informed.

His remarkable equanimity of temper was not a natural gift. It was the result of determined self-control. He was by no means lacking in capacity for anger. Often when things went wrong or when gross carelessness or remissness was apparent, the flashing eye, the clenched fist, the half-smothered oath gave notice of a temper not to be trifled with. But he instantly got a firm grip on it and proceeded to consider dispassionately what was proper to be done. On one occasion he conceived that the manager of one of the companies was not dealing fairly with him. He went to his office for explanation, and in the conversation that ensued felt constrained to use plain, though not abusive, language. The agent ordered him to quit the apartment, which he did without demur. The agent followed, threatening personal violence. He turned on him with an aspect foreboding no child's play. The gentleman retreated, convinced that the job of flogging had better be let out by contract.

I was with him somewhere in Maine, making a test of a water-wheel. Some one placed a chair for his use while recording certain data. On taking his seat, the chair did not happen to be in its assumed position and he fell heavily to the floor. He arose with some sense of personal as well as physical injury, and asked rather peremptorily who had kicked the chair from under him. A workman explained to him that his heavy overcoat had brushed the chair aside when he attempted to sit down. He resumed his work with the observation: "Fortunately it did not hurt the chair." I have known him to get intensely angry and to indulge in a monologue of furious imprecations, which seemed to operate as a relief from pressure, but I never knew him to act from a feeling of vexation. He deferred action until he was able to consider the matter calmly.

Mr. Francis' professional history strikingly illustrates the specializing tendency of the times in engineering as in other pursuits. At first he busied himself not only with water wheels, but with the designing of mills, the arrangement of shafting and machinery, with boilers, engines and chimneys, with questions of sewerage and town water supply, with problems of navigation. As specialists arose worthy to be entrusted with these various matters, he withdrew his attention from them, one by one, till in the latter part of his life he confined himself almost wholly to questions of water-power, and even then found more demands upon his time than he desired.

The conflict of interests in flowing waters gives rise to an immense amount of contention and litigation. It was on questions of this kind that he found his chief employment outside of his regular duties in later years. His accurate judgment, his thorough knowledge, his keen discrimination, which seized upon the vital elements of the case and cast aside all sophistry and extraneous and irrelevant matters, made his services as expert and arbitrator of great value to those who desired an equitable adjustment of their claims.

He not only had the power of controlling his temper, but the equally happy faculty of restraining the expression of opinions which did not run in the popular groove and might involve him in discussion and argument, which he always aimed to avoid. I never had any idea of his views on religious questions until near the close of his life. In conversation with a minister, who declared that the future employment of men would consist in singing the praises of God, he remarked that God "must be a very stupid old fellow to care for so much praising." He affirmed that religious doctrines, ordinances and observances were chiefly valuable as giving employment to the minds of men and keeping them out of mischief. I have no doubt that he approached his end with sentiments very similar to those of Socrates:

> If death be but the lying down to sleep wherein no dream can come, then I say that to die is to gain. For of all the days of our lives, how many days can we remember that passed so pleasantly as a night without dreams? But if it be, according to the common report, a migration hence, where I shall meet with Anaxagoras and Aristogiton, with Homer and Heslod, with Orpheus and Musaeus, with Odysseus and with Ajax the son of Telemon, and with ten thousand other men and women whom I might mention; where I shall learn of him that is wise and question him that thinks he is wise, but is not, then assuredly death is not an evil thing. For know this of a truth, O judges, that no evil can befall the just man here or elsewhere. And now it is time to depart. You to life and I to death. Yet which of us to the better fate is known only to God.

It was in the closing hours of his life that the massive strength of his character stood fully revealed. His disease was an abnormal growth on the interior of the bladder. I visited him, at his request, after he had taken up his abode at a private hospital in Boston. With true scientific interest, he exhibited to me the instrument devised for examining his disease, consisting of a tube containing a minute electric light, with a combination of lenses, by which the interior of the body can be seen. Such an instrument under such circumstances would have inspired an ordinary man with a feeling of

dread. He saw in it nothing but a wonderfully ingenious adaptation of scientific principles to a desired end. Later, I saw him after a surgical operation had been performed, and a metallic tube inserted in place of the natural duct severed by the operation. He said: "Cast your eye down into this bed and see what kind of a hydraulic apparatus you call this." There was no weakness, no repining, though his mind at some points showed indications of giving way.

And later, when the immaterial part of him was merged in the infinite and the material was ready to be surrendered to the elements that had resumed dominion over it, the countenance wore an aspect of majestic repose, as of one conscious of having endeavored well and ready to meet the judgment of mankind with equal indifference to praise or censure.

## TESTS OF RAPID-FIRE GUNS AT SANDY HOOK.

The official reports of the results of the recent tests of rapid-fire guns at Sandy Hook are not yet made public, but the following are the principal facts, as given in the press reports:

The guns tested were the Driggs-Schroeder, the invention of Lieut. Wm. H. Driggs, U. S. N., and Commander Seaton Schroeder, of the "Vesuvius"; the Maxim-Nordenfelt, of English manufacture; the Hotchkiss, which, though an American invention, is now made in France, and the Sponsel, also a foreign-made weapon. The Skoda gun was represented by a 3-pdr., and passed through the various tests with the others, although not formally in the competition, which was for 6-pdr. guns only. A Seabury gun was also entered, but withdrew for repairs to its mechanism. The weights of the pieces were as follows:

| Name. | Driggs-Schroeder. | Sponsel. | Hotchkiss. | Maxim-Nordenfelt. |
|---|---|---|---|---|
| Wt., lbs. | 786 | 725 | 792 | 756 |

The first test was firing at extreme elevation. Then came the velocity test, in which the Driggs-Schroeder took the lead, its projectile moving at 1,890 ft. per second, followed by the Maxim, 1,865 ft. per second, and the Sponsel, 1,827 ft. per second.

On May 7 a test for rapidity of firing was made. The Driggs-Schroeder fired 100 rounds in 4 min. 5 sec.; Hotchkiss, 4 min. 26 sec.; Maxim-Nordenfelt, 4 min. 41 sec.; Sponsel, 4 min. 59 sec. All the guns were in good condition when examined at the close of the test. The barrel of the guns was then subjected to an interior pressure of 45,000 lbs. per sq. in., which was sustained without injury.

A defective cartridge test was then tried. Two kinds of defective cartridges were used. One had four cuts around the rim running toward the center, and the other had two grooves cut in it, one-sixteenth of an inch wide at right angles across the head.

A Hotchkiss gun was the first tested, and was fired without any injury resulting. The second shot went with only a little difficulty. The mechanism of the Sponsel when fired filled with residue, the breech block could not be opened by hand, but was finally moved by the use of a sledge, and the much-strained mechanical organs were got in working condition after three-quarters of an hour's work. The residue did not stick on the mechanism of the Driggs-Schroeder gun, and the block opened readily after a few light taps with a wooden mallet. The Maxim-Nordenfelt proved impervious to a defective cartridge of the first type, and fired without any difficulty. The grooved cartridges were then tried, and on the first trial the Hotchkiss had to be reopened with a wooden mallet. The Sponsel's mechanism would not work in proper order, but stuck, but the parts were found all right on examination, and the Driggs-Schroeder opened as before without much difficulty upon the application of a tap of the mallet, whereas the Maxim-Nordenfelt still refused to show any signs of improper working, but opened in good condition and easily.

Next the primers of each gun were trimmed down to a sharp point, which would cause penetration of the cartridge cap and result in the powder blowing backward in the mechanism. The Driggs-Schroeder and Hotchkiss succeeded in passing the test admirably, while the Sponsel had its firing pin broken.

A dust test was then made. Each gun was put in a box with some sand and dust, and with the aid of a bellows the gun was kept in a cloud of dust for eight minutes. The time for firing five rounds was then taken as follows:

| | Driggs-Schroeder. | Maxim. |
|---|---|---|
| Time of 5 rounds | 3 min. 20 sec. | 3 min. 27½ sec. |
| " of second trial | 5 " 55½ " | 4 " 27 " |
| | **Sponsel.** | **Hotchkiss.** |
| Time of 5 rounds | 8 minutes. | 38 min. 39 sec. |
| " of second trial | —— | 22 " 47 " |

The second trial was made at the request of the Hotchkiss representative.

A "dry" test was then made, all oil being washed from every part of the guns and all parts wiped dry. The results are not at hand. A rust test was made by immersing the guns in a solution of sal-ammoniac for 48 hours. After this severe treatment the blocks on all the guns had to be driven out with a sledge. Five rounds were then fired in the following times:

| Gun. | Maxim-Nord. | Hotchkiss. | Schroeder. | Sponsel. |
|---|---|---|---|---|
| 5 rounds. | 6 min. 2 sec. | 35 min. | 1 h. 8 min. | 7 h. 30 min. |

Following these tests another test for rapidity of firing was made to see how many rounds each could fire in one minute and three minute intervals, with results as follows:

| Gun. | Driggs-Schroeder. | Hotchkiss. | Sponsel. | Maxim. |
|---|---|---|---|---|
| 1 minute | 34 | 28 | 24 | 20 |
| 3 minutes | 83 | 83 | 73 | 65 |

In a test for accuracy of firing at ranges of 1,000 yds., one mile and three miles, the Driggs-Schroeder ranked first and the Maxim-Nordenfelt second.

## ELECTRICAL SMELTING IN GERMANY.*

Among the recent German inventions in metallurgy, one of the most interesting, by reason of its simplicity and its probable value in practical application, is a process invented by Mr. Edward Taussig, of Bahrenfeld, for the smelting and casting of metals by electrical heat, under the influence of rarefied air. The operation consists in fusing ores or metals in a closed furnace or chamber, the hearth of which is connected with molds into which the fused metal flows by gravitation, and is cast into any desired form, and in both of which (molds and furnace) the air has been rarefied as far as practicable through exhaustion by air pumps or other mechanical means.

The apparatus includes a long, air-tight smelting channel or chamber, the hearth of which inclines to a central orifice, through which the fused metal passes into the molds. This chamber is filled with the metal to be smelted, and heat is generated by passing an adequate current of electricity through the mass without the use of any kind of fuel, or the employment of carbon electrodes. In this latter respect, the inventor of this process claims that it is entirely original and distinct from all other electrical smelting systems now in use in this country. The furnace is lined with glazed fire bricks, which are so efficient a non-conductor of heat as to insulate quite perfectly the contents of the chamber, so that the heat is developed where it is required evenly throughout the mass, and very little, if any, loss of current is experienced. From the testimony of experts who have examined this process in operation, it appears that a degree of heat sufficient to smelt pig iron in 15 minutes can be generated and maintained without unduly heating the other parts of the circuit, and this is equally true of the smelting of easily fused metals like lead and zinc, and of Siemens-Martin steel of Swedish origin, which is known to be one of the most refractory of all the useful metals.

The entire absence of coke, coal, or carbon electrodes secures to the fused metal nearly absolute purity, and the continued exhaustion of air and the gases generated by smelting increases the fluidity of the molten material and wholly prevents oxidation and blistering and produces castings of a dense, smooth quality, which have shown, under elaborate tests made by unimpeachable authority, the highest mechanical qualities of which cast iron is capable.

Without attempting to estimate the practical value of this process or its future range of application, it is fairly within the province of the present report to consider what may be reasonably inferred as to the limitations by which the industrial process will be restricted, and its probable economic efficiency for smelting and casting. For smelting raw ores, the most obvious advantage claimed for it is that it can be worked wholly by water power and without fuel in mountainous and remote districts which produce ores and have abundant water, but no coal.

For fusing iron, steel or other metals for casting purposes, the advantages claimed are rapidity of operation, improved quality in the castings, susceptibility of continuous working, and—even where steam power is used to generate the current—an economy of fuel which is estimated from 30 to 50% of the coal used in smelting by the ordinary method. From what has been already stated, it would appear that the practical limit of capacity will be a furnace or fusion channel from 36 to 40 ft. in length, and capable of containing at one charge about 1½ tons of metal. By working such a furnace with a current of 30,000 amperes and 50 volts (which would represent a force of about 2,000 HP., or somewhat less than the energy employed in the reduction of aluminum at Neuhausen) the entire charge of 3,000 lbs. can be fused and run into castings within 15 minutes. By repeating the operation as rapidly as the charge can be replaced and melted, a single furnace of this capacity can be made to turn out in a working day a large quantity of castings, and when motive power for generating the current is supplied by water, or even by steam, made with a cheap quality of coal, the economy of the process over present methods would seem to be obvious.

Comparisons have been made with the well-known results of making iron and steel castings by melting in a Siemens-Martin regenerative furnace, where from 1,000 to 1,400 lbs. of coal are burned to melt 2,000 lbs. of iron. Assuming that water power for the Taussig process is not available, and that the dynamo and air pumps must be worked by steam, it is claimed that the same result, viz., the melting of 2,000 lbs. of iron or steel, can be effected by the consumption of from 720 to 800 lbs. of steam coal, an economy of 50% in the use of fuel. This economy is still greater, if, instead of the foregoing comparison with smelting in a Siemens regenerator, we consider the treatment of steel in crucibles, where 1,200 lbs. of the best coal is consumed for each 1,000 lbs. of steel, and this proportion is increased to 1,500 or even 1,600 lbs. when the coal used is of inferior quality, and yields a large percentage of ash. It is, therefore, confidently asserted by experts who have examined this new electrical (vacuum) smelting process that it will secure a saving of more than half the fuel that is now required for the fusion of steel in crucibles, and that the saving would be proportionately greater under conditions which would enable the current to be generated by water power.

(The author of the above does not appear to be aware that cast iron is melted in cupola furnaces and with a fuel expenditure amounting to only a sixth or a seventh of the weight of the iron melted.—Ed.)

While the preliminary experiments, which have been conducted with a current of 18 to 20 HP., have been brilliantly successful, with resulting products of high and uniform quality, the practical application of this new process on an industrial scale has yet to be made. Works have been built at Copenhagen, where it will soon be put into practical operation, and a syndicate has been organized for a similar purpose in southern France. The first use of the system will be in the production of small castings of iron and steel, in which high quality, smoothness of surface and freedom from flaws and air holes are especially important. In the earlier experiments, four-bladed propellers of a size suitable for electrical or steam launches, were cast with such excellent results that the ultimate success of the process for fine castings up to a certain size would seem to be assured.

In the production of pig iron and other metals direct from the ores, greater difficulties will no doubt be encountered, for the reasons, among others, that the charge to be smelted will be necessarily small, and the furnace must be so constructed as to provide for the elimination of the slag. The experiments in this direction have been made thus far on only a small scale, but the produced iron, owing to the absence of coal or coke and the prompt withdrawal of the air and gases generated by smelting, is very pure.

It is estimated that with a plant equipped with a motive force of 500 to 600 HP., and supplied with good, ordinary 48% ore, the cost of producing a ton of pig iron (allowing $2.40 per ton as the price of the ore) would not exceed $9.65, and this, in the opinion of the inventor, could be easily reduced to $8 per ton if a motive power of 1,000 HP. were employed.

Putting aside all mere conjectures and theorizing, and adhering strictly to what has been thus far accomplished, the record of actual results would seem to be:

1. It has been shown that by this process a degree of heat sufficient to smelt a ton or more of iron within 15 minutes may be generated, sustained, and applied at will without the use of carbon electrodes and without excessive heating or injury to other portions of the circuit.

2. Castings of iron and steel, up to a weight of 200 lbs. or more, have been made, which have shown all the desirable qualities—smoothness of surface, fineness of texture, and freedom from much of the impurities which are always more or less incident to smelting by ordinary methods.

3. Pig iron of excellent quality has been produced in small quantities by direct smelting from Swedish ores.

* Abstract of a report by Mr. Frank H. Mason, U. S. Consul-General at Frankfort, Germany.

## PERSONALS.

Mr. W. S. Jones has been appointed General Superintendent of the South Carolina & Georgia Ry., vice Mr. J. M. Turner.

Mr. D. McN. Stauffer, Editor of Engineering News, sailed from Southampton for New York on the steamer "Paris" of the International Line, on July 7.

Sir Austin Henry Layard, the noted explorer of Egypt and the discoverer of the ruins of many of the ancient eastern cities, including those of Nineveh, died in London July 5.

Mr. J. H. Sundwater has been appointed First Assistant County Engineer of Hamilton County, O.; Mr. H. E. Knorr, Second Assistant, and Mr. J. Edward Breen, Third Assistant.

Mr. G. Gunby Jordan, of Columbus, Ga., General Manager of the Georgia Midland & Gulf Ry., has been appointed Railway Commissioner of Georgia, vice the late Mr. Virgil Powers.

Mr. Willard Bullard, Chief Sanitary Inspector in the Health Department, New York, died July 1. He was appointed in 1884, and instituted the regular house-to-house inspections in the tenement districts.

Mr. S. O. Lewis, Superintendent of Transportation of the Mexican Central Ry., has been appointed Division Superintendent of the road, with headquarters at San Luis Potosi, vice Mr. M. S. McCay, resigned.

Mr. Sol Haas, Traffic Manager of the Richmond & Danville R. R., has been appointed Assistant to the President of the reorganized road, now termed the Southern Ry. Mr. John M. Culp, Assistant Traffic Manager, has been appointed Traffic Manager.

Mr. Burton J. Ashley, of Chicago, who is engineer for the system of waterworks now under construction at Marengo, Ill., was recently appointed engineer for the village of Morgan Park. He has moved his office to the Title & Trust Building, Washington St., Chicago.

Mr. Albert C. Gorgas, Medical Director, U. S. N., recently in charge of the naval museum of hygiene, has been appointed to represent the Navy Department at the International Congress of Hygiene and Demography, to be held at Budapest, Hungary, in September.

Mr. Frank D. Jones, Chief Engineer of the Glendon & Gulf Ry., has been appointed Superintendent of the road, in charge of the operating and traffic departments, with office at Glendon, N. C. The office of Chief Engineer is abolished and the duties of that office will be attended to by the superintendent.

## NEW PUBLICATIONS.

JULY MAGAZINES.—"Scribner's" this month has an article by Ernest Flagg, the architect, outlining a plan for curing the tenement-house evil in New York. Mr. Flagg lays down at the outset the novel proposition that the fixing of the size of building lots at 25 × 100 ft. is the greatest evil that ever befell New York city, a claim which engineers laying out city lots (there are not as many engaged in this work as there were a few years ago) would do well to investigate. Mr. Flagg proposes to substitute for the present long and narrow type of tenement-house a structure nearly square in plan and with an open court in the center. Such a structure would give a greater floor space available for rental on a given ground area; all its rooms would be well lighted and habitable, and at the same time it would be actually cheaper in first cost, inasmuch as there is a less amount of wall for area covered and less space wasted in corridors. Mr. Flagg's paper deserves careful study by every one interested in the tenement-house problem, and by every architect engaged in the planning of city dwellings. The number also contains an interesting description of the Tarahumari Indians, who dwell in the Sierra Madre Mountains in Mexico, and a paper by Prof. N. S. Shaler on "Beasts of Burden."

In "Harper's" we find a paper with the rather fanciful title "The Storage Battery of the Air," in which the author gives some interesting particulars respecting the measurement of the potential of atmospheric electricity; he suggests as among the possibilities that atmospheric electricity may yet be utilized. Morse was commonly said to have "harnessed the lightning" a half century ago; but this scheme would be the reality. As far as we can now see, however, so long as we have such a store of other sources of energy in nature which are utilized only imperfectly, we are not likely to trouble ourselves to harness such a fitful, erratic and dangerous steed as the lightning, even though the harnessing should become a theoretic possibility. Commander Theo. F. Jewell, U. S. Navy, contributes an illustrated description of the naval gun factory at Washington, of which he is superintendent.

In the "North American Review" we find a paper on "The Prospects of Mexico," by W. M. O'Dwyer, in which a glowing view is taken of the financial and commercial prospects of our sister republic. Mr. F. A. Mitchell writes on "How to Make West Point More Useful," Briefly stated, he would increase the number of students and utilize the graduates who did not take service in the regular army as officers of the National Guard. The postal service at New York is described by the present postmaster, Hon. Chas. W. Dayton. It is interesting to note that the gross receipts of the New York postoffice are over $7,000,000, and the net receipts over $5,000,000.

THE STEAM ENGINE AND OTHER HEAT ENgines. By J. A. Ewing, M. A., etc., Prof. Applied Mechanics, Univ. Cambridge. New York and London: Macmillan & Co. 8vo; pp. 400; 185 cuts; $3.75.

The first thought that strikes one on picking up this volume is how admirably it is printed. There is a neatness in the paper, press work, type and general arrangement of English scientific works which our scientific publishers rarely approach—a fact they would do well to note, as the difference in expense is comparatively trifling for very decided differences of quality; and, moreover, this difference is often in favor of the English book, since both the appearance and the cost of the American book is injuriously affected by using heavy paper and monstrously large type in order to make a small book bear a large price. Our works in general literature are, as a rule, so tastefully printed and bound that this contrast in respect to scientific books is all the more curious.

Coming to the merits of the treatise itself, these also are great, though the work is only to a limited extent new, it being an expansion and revision of the very able article by the author on the Steam Engine (which includes other heat engines also) in the Encyclopedia Britannica. The book calls for no extensive review, therefore, as that article and its merits are already sufficiently well known. So good a one was certainly never published before in any encyclopedia, and the revisions and expansions to convert the article into an up-to-date text-book are in general very judicious.

We notice, however, that one very extraordinary misstatement of the original article is still adhered to here. As it does a very great injustice to the memory of Sadi Carnot we are sure that the author's attention only needs to be called to it to insure correction in all future editions, since the just fame of a dead scientist will be zealously cared for by all his living fellows of honorable instincts. On p. 30 Professor Ewing says:

> The theory of the steam engine as a heat engine may be said to date from 1824, when Carnot published his "Reflexions sur la Puissance Motrice du Feu." He there showed that heat does work only by being let down from a higher to a lower temperature. But Carnot had no idea that any of the heat disappears in the process, and it was not until the doctrine of the conservation of energy was established in 1843 by the experiments of Joule," etc.

The same statement in substance is to be found in Rankine and many other English authors. It is gravely erroneous, and apparently has resulted from the fact that, until Professor Thurston filled this gap by an English edition (Wiley & Sons, publishers) of Carnot's famous work and his accompanying notes, all the knowledge of Carnot among English authors was derived, not from Carnot himself, but from Sir William Thompson's abstract of his work, which rarely quoted his exact words, and which made no reference to his notes, which, we may reasonably infer, Sir William himself had never seen nor heard of, or several statements of his famous monograph which did so much to establish Carnot's fame would probably have been different.

In those notes, however, Carnot not only clearly shows that he had an "idea" that "heat disappears in the process," but distinctly and repeatedly shows just how and why it should disappear, and in general states with extraordinary clearness, force and perspicuity the probable nature of heat, the experiments by which this nature can probably be proved and even the probable mechanical equivalent of heat, which last he foresees with such precision that it differs only by a trifling percentage from that determined by Joule a generation later. Nevertheless, Carnot was at that time unable to prove the truth of this wild and startling speculation (as it would certainly have been regarded at the time), and moreover, he saw or thought he saw that that theory involved certain consequences, stated by him, which may or may not be true (they are not now accepted, but they have never yet been disproved), and which he very properly and rationally declined to assume until demonstrated. For this reason, as he himself states in the most explicit language, he conducted and published his famous analysis "according to our present ideas of the nature of heat," a little phrase which apparently failed to catch the attention of Sir William Thompson, and which has correspondingly been overlooked by most of his successors. We forbear to enter further into this interesting question, as full discussion would require considerable space, and would be more appropriate in a separate article; but the most superficial examination of Professor Thurston's or the French edition of Carnot's complete writings will convince Professor Ewing that in several places the general tone of his comments on Carnot does his memory a great wrong, and he will then, we are sure, feel the same desire that we do to correct the error.

AMERICAN STREET RAILWAY INVESTMENTS: A Supplement to the "Street Railway Journal." New York: Street Railway Publishing Co. 4to; pp. 216; 24 maps; $5.

Street railways within the last ten years, or since electricity and the cable came into extensive use, have become favorite investments. In the change from animal to mechanical traction a large amount of capital has been absorbed with the result of greatly broadening the market for this class of securities. The stocks and bonds of many street railway companies now hold equal rank in money markets with those of the leading steam railways, and as their merits become better known, it is believed that they will gain in favor with investors and become favorite securities on the principal exchanges. This book is the first publication giving, in a comprehensive and systematic manner, detailed information regarding the operation and management of the different properties, and there is no doubt that there will be a large demand for it by railway and financial men. The cities and towns are arranged alphabetically, and particulars are given of the mileage, track, equipment, power plant, finances and statistics of operation of each railway. The population of each place is also given, together with particulars of the commercial interests and financial conditions in the case of the larger cities. The 24 maps show the street railway systems of several cities. There is, however, no general tabular summary showing the extent and importance of the street railways of the country in the aggregate, an omission which should be remedied in future editions. The book is well printed, on good paper.

REPORT OF THE ELEVENTH ANNUAL MEETING OF THE STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK: Held at Rochester, N. Y., September, 1893. Secretary, W. J. Richardson, Brooklyn, N. Y. 8vo; pp. 62.

This volume contains a report on "The Return Circuits of Electric Railways," with discussion, and the general business and social proceedings of the meeting.

### TRADE PUBLICATIONS.

TUBULAR FRAME CARS.—The Iron Car Co., New York. 8vo oblong; pp. 24; illustrated.

This pamphlet contains a number of testimonials from users of these cars (which have been described at various times in our columns), including railways in Europe, Australia and Chile. The Bloomsburg Car Co., which built 800 of these cars, states it can construct more per day of these than of the wooden frame cars.

TURRET LATHES. Gisholt Machine Co., Madison, Wis. Oblong 8vo; pp. 12; illustrated.

This is the June number of the company's monthly publication showing some of the uses to which its turret lathes are put. There are four fine half-tone illustrations representing machines for boring and facing work and screw cutting and a universal tool grinding machine.

## SOCIETY PROCEEDINGS.

CIVIL ENGINEERS' CLUB OF CLEVELAND.—At the meeting on June 12 Prof. C. F. Mabery presented a paper on "The Composition of Ohio and Canada Petroleum." F. S. Osborn, Secy.

IRRIGATION CONGRESS.—The third National Irrigation Congress has been called by the National Executive Committee to meet in Denver, Colo., for the seven days beginning Sept. 3.

INTERNATIONAL CONGRESS OF HYGIENE AND DEMOGRAPHY.—The congress will be held at Budapest, Hungary, in September. The Navy Department has appointed Mr. Albert C. Gorgas, Medical Director, U. S. N., as its representative.

### COMING TECHNICAL MEETINGS.

ENGINEERS' CLUB OF KANSAS CITY.
July 16. Secy., Waterman Stone, Baird Building.
WISCONSIN POLYTECHNIC SOCIETY.
July 16. Secy., M. F. Schinke, City Hall, Milwaukee.
ENGINEERS' CLUB OF MINNEAPOLIS.
July 16. Secy., E. Nexsen, 504 Kasota Block.
COLUMBIAN ENGINEERING SOCIETY.
July 17. Secy., F. W. Hart, Washington, D. C.
BOSTON SOCIETY OF CIVIL ENGINEERS.
July 18. Secy., S. E. Tinkham, 36 Bromfield St.
SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO.
July 19. Secy., Howard Berge, 100 Washington St.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
July 19. Secy., Daniel Carhart, Carnegie Lib. Bldg., Allegheny.
TACOMA SOCIETY OF ENGINEERS AND ARCHITECTS
July 20. 201 Washington Building.
DENVER SOCIETY OF CIVIL ENGINEERS.
July 24. Secy., F. E. King, Jacobson Block.
WESTERN SOCIETY OF ENGINEERS.
Aug. 1. Secy., Thos. Appleton, Lakeside Bldg., Chicago.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
Aug. 3. Secy., O. Von Geldern, 719 Market St., San Francisco.
ENGINEERS AND ARCHITECTS' CLUB OF LOUISVILLE.
Aug. 9. Secy., G. W. Shaw, Norton Building.
NORTHWEST RAILWAY CLUB.
Aug. 14. Secy., W. D. Crosman, Ryan Hotel, St. Paul.
NORTHWESTERN SOCIETY OF ENGINEERS.
Aug 14. Secy., D. W. McMorris, Burke Blk., Seattle, Wash

# ENGINEERING NEWS

AND

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There is a general tendency nowadays whenever any fire occurs the cause of which cannot be ascertained, to lay the blame upon electricity. Perhaps the most notable of recent great fires which has been charged against electricity was the conflagration which destroyed the Brooklyn Tabernacle on May 13. As many of our readers will recall, the only electric wires in the church were those that supplied current to the lamps on the front of the organ and to the motor which operated the bellows. The fire broke out in the organ, and as a consequence all the published reports of the conflagration claimed the electric wires to have been the cause. As soon as investigations came to be made, this first hasty conclusion was seen to have little to support it; but a story once sent abroad by newspaper headlines has done a work that later corrections cannot undo. Probably nine-tenths of the newspaper-reading public still hold the belief that the Tabernacle fire was set by electric wires, and the reputation of electricity as a safe lighting agent must suffer in consequence.

It is important, however, that engineers should not be thus misled. We have been at some pains to ascertain the facts respecting this most notable conflagration, in which electric wires had to stand the blame, and give prominence here to the official report of the Brooklyn Fire Department official who investigated the Tabernacle fire, as follows:

Hon. F. W. Wurster, Commissioner Department of Fire.

Sir: I herewith submit the result of my investigation as to the probable cause of the disastrous fire that destroyed Talmage's Tabernacle and the Hotel Regent, on Sunday, May 13, together with the testimony taken in the matter.

The fire was first discovered at about 12:20 o'clock, just after the services were over, and the pastor was shaking hands with those of the congregation who had remained for this purpose. Smoke was observed on the west side of the organ, and the attention of the sexton was called to the same. He went into the pit immediately under the organ, to investigate the matter, accompanied by Messrs. Lawrence and Ferguson. In this pit were located all the electrical apparatus, motor, resistance box, etc., used to give power to the organ. Everything was all right there, no smell of smoke, nor any appearance of fire; Sexton Dey then climbed a short ladder, about 9 ft. high, leading from the pit to the organ loft, said loft being about on a line with the main floor of the church; he opened a scuttle and looked into the loft; he saw fire on the floor to his right as he looked toward the rear wall of the church, and saw at once that the organ was on fire and hastily retreated.

There was no electrical machinery or wires where the fire was seen by Dey, nor does it seem possible that any disarrangement of the electrical appliances could have caused this fire; had this been the cause of the fire it seems almost a certainty that it would have begun in the pit, whereas the testimony is undisputed that no fire or appearance of fire was seen in that pit. * * * *

It is impossible to say positively what caused this fire, but my deliberate opinion is, after carefully considering without prejudice all the probabilities of the case, that it was due to the carelessness of the organ adjusters and to no other cause. The organ and church were constructed of very inflammable materials, and in a very few moments after the fire was first located by Sexton Dey the whole structure was a mass of flames, and a number of persons had a narrow escape of their lives.

I would suggest that an ordinance be passed prohibiting under heavy penalties the use of lighted candles, striking matches or any exposed lights in organ lofts, and that lanterns only should be used for lighting purposes by workmen and tuners in the interior of organs. Respectfully, Robert F. Rice,
Assistant to Fire-Marshal.

Brooklyn, May 29, 1894.

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The test of a small electric railway plant, printed on another page of this issue, is an interesting record of the result obtained under the conditions of daily service on a suburban electric road nearly 11 miles in length, and operating only three cars. These suburban electric roads with thin traffic are already numerous, and promise to become still more so. They are to be an important factor in the development of suburban properties, and the solution of the rapid transit question in all the smaller cities. The figures respecting their economy are therefore of much interest. Referring to the tabular report, it will be seen that the engine developed an average of 79 I. HP., with a consumption of 24½ lbs. of steam per I. HP. per hour. Of this power about 10 HP. was absorbed by the friction of engine, air pump and boiler feed pump, and about 15 HP. more was taken up by the main belt, the armature shaft and the electrical resistance of the dynamo. The loss in the line transmission and in the car motors is not stated, but it will be seen that about 38 lbs. of steam were used by the engine per hour for each electrical horse-power actually delivered by the dynamo.

The reason for this excessive steam consumption is, of course, the great variation of load under which the engine and dynamo are run, together with the fact that the average load is only about one-half that at which boiler, engine and dynamo could be run most economically. Of course with cheap fuel this loss of power may be comparatively unimportant, regarded merely as a percentage of the total operating expenses. The possibility of making a saving, however, still remains, and engineers are not likely to rest content until some nearer approach to the possible limit of economy is made. What is needed is some method of equalizing the demand on the power plant; and it may yet be found that the storage battery can be made to pay a profit as a part of the equipment of electric railway stations.

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Among the results of the test, a fact worthy of especial notice is the very large consumption of steam by the jet which atomized the fuel oil in the furnace. About one-seventh as much steam was required to spray the oil in the furnace as was produced by its combustion. We frequently hear it said that one great advantage of oil fuel is that it does away with hand stoking of fires, and is delivered in the furnace without cost. When we come to consider the matter, however, it is evident that a steam jet for spraying oil in the furnace is merely an automatic stoker. If any steam user were invited to buy, or even to take as a gift, an automatic coal stoker which required one-seventh of all the steam the boilers made to run it, he would be apt to decline with thanks. Yet it is well nigh universal in the use of oil as fuel to spray it with a steam jet without a passing thought as to how much or how little steam is used in that way. It is a fact too little appreciated by steam users and even by engineers, that a very small hole will discharge a surprisingly large amount of steam. But the steam jet is such an easy means of getting power for helping out the draft, blowing oil over the fire, or spraying oil fuel, that it is very generally adopted for these purposes with little thought of the amount of steam that is thus blown to waste.

It may be claimed that the steam consumption of the atomizing jet in this boiler was exceptionally large; but such other tests as are at hand hardly bear this out. An exhaustive series of tests of the St. Paul and Minneapolis electric railway plant, made by Messrs. Wm. A. Pike and T. W. Hugo, and reported in a paper read at the International Engineering Congress a year ago,* showed an average steam consumption in the fuel oil atomizers equal to 13.4% of the total made by the boilers. In the same test, when the steam used by the oil feed pumps was taken into account, the total steam used in handling oil was 15.9% of the total steam made by the boilers.

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These figures are worth careful attention by all who use or contemplate the use of oil fuel. If they are fairly representative of general practice, they point undeniably to the conclusion that some more economical method of placing oil in the furnace should be adopted. It is too evident to require demonstration that to use over 2 lbs. of steam to put 1 lb. of oil in the furnace, as was actually done in the Detroit tests, is a very wasteful use of the steam. It is further to be borne in mind that the steam thus sent into the furnace causes a total loss of heat proportional to the excess of temperature above the feed water temperature at which the hot gases are discharged. Thus in the Detroit tests 5064.5 lbs. of steam were used to spray the oil during the test of 17⅓ hours duration, and the actual loss of heat, therefore, is not that represented by 5064.5 lbs. of steam at the boiler pressure, but by that amount of steam superheated to a temperature of probably some 500°.

With the use of air to spray fuel oil, on the other hand, the spraying jet takes active part in the combustion. We have seen claims that the steam consumption of an air compressor supplying an air jet for spraying fuel oil was only 2% of the steam made by the oil. Again, in a test by Prof. J. B. Denton on the pumping plant of an oil pipe line at Laketon, Ind.,** an oil atomizer was used, supplied with air by a Root blower delivering 240 cu. ft. of air per minute, and driven by a small engine whose steam consumption amounted to only 1½% of the total steam evaporated by the boiler. It is evident from this test that it is possible to burn oil for steam making with far less waste than occurs when a steam jet is used. There may be cases, of course, where fuel economy is of so small importance that the simplicity and cheapness of the steam jet will make it preferable, but as a rule the terms on which fuel oil is sold make it worth while to consult strict economy in its use.

It has been claimed, however, by many engineers that less perfect combustion is obtained when air is used for spraying the oil than when steam is used. The probable reason for this has been recently pointed out by Mr. H. L. Gantt, M. Am. Soc. M. E., in our contemporary, the "Iron Age." At ordinary temperatures fuel oil is a rather thick and viscid liquid. If compressed air is used for spraying, especially if used at any considerable pressure, the tendency is to cool the oil, as the air when expanded may be far below freezing point. With steam for spraying on the contrary the oil is heated and becomes as fluid as water. The logical conclusion, of course, is that where air is used for spraying, it should be passed through a coil of pipe exposed to the fire; in this way it can be made even more efficient than steam in heating the oil; and, further, the heating after compression will result in a large economy in its use, as its volume will be increased with no greater work done by the compressor or blower.

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* Trans. Am. Soc. M. E., vol. XIV., p. 1,111.
** Trans. Am. Soc. M. E., vol. XIV., p. 137.

## THE LATEST GREAT RAILWAY STRIKE AND ITS LESSONS.

In our issue of June 7, in an editorial discussion of the problem which train stealing by Coxey marauders and bands of tramps presented to railway managers, we advocated the policy of throwing the responsibility of protection of property and employees upon the legal authorities. In the great strike which, during the past ten days, has paralyzed railway traffic from Chicago west to the Pacific coast the railway managers have followed exactly this policy, and as a result the country has awakened as never before to the fact that this is not a fight between labor and capital, or between corporations and employees. It is a contest between the Government and anarchy, between those who seek to destroy life, liberty and property and all the forces of the Government, which was founded and exists to make life, liberty and property secure.

Moreover, the issue is presented so clearly in this case that all the intelligence and patriotism of the country must inevitably be drawn to the side of law and order. There is no question of wages or hours of labor or of the discharge of this or the retention of that man, or of the enforcement of rules or requirements—questions over which industrial battles are usually fought. The record is simply that the leaders of a labor organization ordered the railways to violate their contracts with the Pullman Co. or be "tied up," and the railways refused to submit to the dictation. For if they should yield to this demand, where could any stand be made? If the supreme ruler of the American Railway Union can compel railways to break contracts, why may he not compel them to make contracts? And granting the meek submission of the railways to these two classes of dictation, it is plain that the labor leaders would have an instrument in their hands which could be made more profitable as a means of blackmail than all the supposed numerous sources of revenue of the New York police force.

It is to be noted that, for the most part, in this great strike the men were not discharged; they simply left voluntarily and in a body, and not only on roads which run Pullman cars, but on all the roads centering at Chicago whose general managers are united in an association. Further than this, the leaders are confessedly doing their best to bring on a universal strike, not only on all of the railways of the country, but in every industry in which labor is organized and can be controlled. Inevitably in the destruction of communications which has taken place a vast amount of suffering and distress has been, and will be, caused; and it is fortunate, again, that only the most wrongheaded can lay the blame for this upon the railway companies. Bad as the case may seem, a taste for a brief season of what mob law means and what stopping the wheels of traffic on all our great railway lines for a brief season involves may teach a salutary lesson to some millions of people.

When it is realized in any community that scarcity of food and fuel, with accompanying high prices and the stopping of mills and factories, is due to the fact that mobs are preventing the operation of these great commercial arteries, then we may expect a sudden and universal awakening of public indignation, before which mobs and mob law and anarchy will make haste to hide.

The final results of the strike, long as traffic may be delayed by mobs recruited from the slums of Chicago and other Western cities, can be in no doubt. Arbitration is out of the question, because there is nothing to arbitrate. In the majority of cases the men have made no demands whatever. They simply quit work at command of the Union officers. Nor have the railways any issue with their men. All they ask is that their property may be protected from mob violence and the incendiary's torch, and their employees from intimidation and assault. Under these circumstances it would be highly proper for the American Railway Union officers, before calling so loudly for arbitration, to inform the public on what matters arbitration is desired. Lacking this information, their demand for arbitration is about as sensible as would be a similar demand from the toughs who have been committing wholesale theft and arson in the Chicago freight yards.

And now, after all these things are said, and with the full realization of the necessity of putting down and punishing infractions of law with all the force at the Government's command, it is well to study this present crisis, with the object of ascertaining, so far as we can, the employees' point of view, for only by so doing can we form any accurate judgment of the best measures to be taken to prevent other and worse strikes in the future.

In the first place, the fact must be realized that the various criminal acts—the burning of railway property, the assaults upon employees and guards, the wrecking of trains—are not to be taken as indicating the character of the railway employees of the country as a class. If the conductors, engineers, firemen, telegraph operators, brakemen and switch tenders of our railways were, as a class of men, of so little principle as to be capable of such criminal acts, the outlook for the railways would indeed be a sorry one. But every one who is familiar with railway operatives knows that the case is not so bad as this by any means. The fact is, as every observer knows, that any such disturbance as has been in progress is taken advantage of by the idlers, the roughs, and the criminals and semi-criminals in every town and city to assemble and lead in every lawless act. Of course there are not a few hard characters among the strikers themselves, and there is a far larger number who will commit such acts as the tipping over of freight cars or the obstruction of a track in the same spirit of mischief as actuates a party of college boys out on a lark, and with no thought of the serious nature of their act in the eyes of the law.

It is well nigh certain, moreover, that a very large percentage of the men who have gone on strike have done so practically under compulsion. The tyranny which the labor union leaders exert is little realized; but we have only to look about us in these days to see what moral and physical courage is demanded from the employees who dare to oppose and condemn the strike. We may be very sure that in the secret meetings in which one lodge after another has taken action upon the question of strike or no strike, there have been very many who either outwardly or inwardly have cursed Debs and his work.

In general, then, it seems the most reasonable view of the case to believe that a large percentage of the employees who are now out on strike would be at work if they followed their own will and inclination, and also that the disgraceful crimes which have occurred are not sanctioned by the strikers as a body and to a large extent are the work of outsiders.

But notwithstanding these hopeful features, we must still realize the fact that the injury of injuries to the railways, the strike itself—coming like a thunderbolt from a clear sky—is an act for which the whole body of employees, or at least a majority, are directly responsible. With this we must put the fact that a large percentage of them—perhaps a majority—believe that they have done a right and good act in joining this strike. Men do not perform a bad act by calling it bad; they do it because it appears to them to be good. We are speaking, of course, of men with some claim to moral character, such as we conceive the great body of railway employees to be, not of the wholly depraved and vicious. Let us not forget, either, that, ridiculous as it may appear from a legal and logical point of view, this strike is a "sympathetic" strike. We have shown the real meaning of this above in terms too plain to be mistaken; but let it not be supposed that the railway employees who have gone out on strike have had this side put before them. They looked at the question from a wholly different standpoint. It is simply: "Boys, those poor devils up at the Pullman shops are starving. The old man is making so much money off his sleeping cars that he don't care a rap whether his shops run or not. The boys at Pullman can't touch that end of his business. We are the only fellows that can. Let's agree not to haul another one of his cars till he squares up matters with our brothers at Pullman."

We may call it illogical and absurd and wrongheaded, as it is, but we must, nevertheless, recognize the fact that men who will sacrifice their places and their wages, not to benefit themselves in any way, but to help—as they intend it—a body of men who are entire strangers to them, are not wholly bad at heart.

And now, if we have come to understand in some degree what character of men the railway employees of the country are and what is their point of view, we are in a better condition to consider what can be done to bring about better conditions.

The great fact which, in some way or other, must be brought home to the railway employees of the country is that the interests of the companies and their employees are identical. What does the ten or twenty million dollars which the strike has thus far cost the railways of the country mean? It means so many less dollars available to pay labor, so much less patronage for car builders and locomotive builders and workers through the whole range of railway supplies; so much less chance of wages and salaries being raised; so much less work on extensions and improvements.

The wheels of industry have been dragging slowly for a year past. The universal complaint has been that there was not enough work to go around. What has been the reason? It has been simply the timidity of capital; the uncertainties of the times deterred men from investing their money in new industries which would give employment to labor and at the same time increase the number of purchasers for labor's products. And are the scenes which have taken place in the streets of Chicago likely to allay this timidity of capital? Are the flames of burning cars of freight and the silent wheels in hundreds of factories, closed on account of railway blockades, an incentive to enterprise? Who can doubt that the number of poor men's homes which will see hunger and cold this winter as a result of this great strike will outnumber, many times over, the homes in Pullman that the strike was meant to help.

The plain fact is that labor and capital are both necessities of our industrial life. Neither can do without the other. Withdrawal of either means stoppage of all the processes of production and exchange by which the world's wants are supplied. The power of the labor organizations is enormous. They have used it in many industries—as they had a right to do—to increase their wages up to the highest point that the return from the industry warrants; but when they go beyond this—when they attempt to take the lion's share and interfere with the security of capital and the safety of property, they will find themselves in the position of the boy in Aesop who thrust his arm into a narrow necked jug filled with sweetmeats and because he tried to take out too large a handful could take out nothing.

And now the question of questions is, how shall these facts be brought home to the man who works for wages? How can we make the railway employee realize that his interests are the same as those of the company which he serves, and realize it so effectually that such concerted attempts to annihilate the business of the railways as that now in progress shall be impossible?

It may be interesting at this point to examine the statistics just made public by the Interstate Commission, covering railway operations for the year ending June 30, 1893.

Of every $100 which the railways earned in that year, $68 went to pay the operating expenses, $23 more went to pay the interest on the company's debts, and only $9 was left to pay dividends to the stockholders. It is safe to say, taking the country over, that at least five-eighths of the total operating expenses consist of employees' wages; and, of course, as a matter of fact nearly all the remainder paid for supplies goes to pay wages. It appears then that five dollars was paid to railway employees for every dollar that the roads earned for their owners. There is some talk in the air in these days that the present strike may wind up with a general increase of wages. It is evident from the above that if wages were increased 20 per cent. all around, which many of the labor leaders would probably regard as a very moderate increase, the owners of the roads would receive no return whatever from their property. We sympathize with the wish of the laborer to have his share of the proceeds of industry, but it is difficult to see on what grounds he can claim the whole.

Another fact which should not be overlooked in this connection is that in the year for which these statistics are given the railways were unable to pay the interest on a debt amounting to $697,137,000; and that stock to the amount of $2,859,334,-

572 paid no dividends. Let the employee not forget that he has the first claim on the earnings, and that he always gets his pay when it is due, while the men who have lent money to the railway may have to whistle for their pay, and the owners get either nothing at all, or at best only an insignificant fraction of the earnings.

It would be a great gain if in some way these facts and figures could be brought home to the railway employes of the country. If they could be once brought to comprehend the fact that the bulk of the money that the railways are taking in is flowing directly into the employees' pockets, and that the operation of the railways, if we measure by the dollars and cents standard, is benefiting the employees far more than either the owners or the creditors—if the employees once realized these truths they would be as eager to protect and defend the interests of the railways as they now are to injure them.

It is worth while asking at the present time whether there is any way by which the interests of the companies and the employees could be more closely united, and the latter be made to appreciate better that their interest lies in defending the companies, not in conspiring against and attacking them. Several railway officers have at different times planned to effect this by making railway employees stockholders. The objections to this are in the first place that few if any railway stocks are suitable investments for the man of small means at the present time. On a large proportion of the roads the stock represents nothing but voting power plus a dim prospect of intrinsic value at some distant day. Neither of these is any inducement to the investment of money by the man who works for wages. Further than this, the amount of capital which the employees as a whole could invest would be too small to cut any important figure compared with their wages.

What appears to be the most hopeful direction in which to look for improvement is in the hiring of employees on a different basis. Let us not forget in the midst of these days of strikes that serious as is the case when all the workers leave their places at once, it is no more serious than the predicament that has stared many a poor fellow in the face, when without previous notice he has been sent packing, and had to go home to wife and family with the news that their means of subsistence was cut off. What is needed is a tenure of position that shall insure a man reasonable notice prior to his discharge, and insure to his employer like reasonable notice prior to leaving his work. Doubtless it would be difficult to apply this to the lowest grades of the service, but we see no reason why on engaging an engineer, conductor or telegraph operator a written contract might not be entered into by which each party should deposit an equal sum of money with some designated third party, and in case either employer or employee terminated the contract without giving a certain notice, his deposit should be forfeited to the other. Contracts and arrangements of this sort are common in hiring employees of a higher grade. By extending these principles to the important classes of employees above named there would be fair security that they would be held loyal to the road in such times as the present.

Already something of a step in this direction of definite contracts between employer and employee has been made by some of the older railway labor organizations, such as those of the engineers, firemen and conductors. The good effects of even these contracts have been noted to some extent during the present strike. Of course the standing objection to them is that one party is responsible while the other is not. This can be remedied when the labor unions are in position to put up bonds for the fulfillment of the obligations into which they enter.

That the present serious crisis will result in some effort toward the establishment of better relations, with less opportunity for rupture between the companies and their employees, admits of little doubt. Every one sees that the paralysis of railway traffic by labor disputes is an anomaly that ought not to exist. To reach the difficulty by law, however, is far from an easy task, and much better results are to be hoped for in the direction we have outlined, by educating employees to appreciate the fact that their employers' interest is their own, and at the same time making more stable the tenure of their positions.

## LETTERS TO THE EDITOR.

### USE OF A BY-PASS WITH A POWER PUMP.

Sir: Can you or any of your readers tell me whether any small water-works are operated in a way similar to the following: There is a prime mover now driving important machinery requiring uniform speed, and there is a surplus of power. A geared pump can be connected with the line shaft, but it must run at a constant speed, and naturally at one which will deliver the greatest quantity of water which the community will require. At times only a small proportion of this, perhaps one-fifth or one-tenth, will be wanted.

Is it practical to place a "run-around" pipe having a valve in it between the delivery and the suction pipes, and control the amount of water sent into the pipe system by opening or closing the valve more or less; and would the pump work well under such use? A similar construction is in use on steam fire engines, but these are always under close inspection and the "run-around" or "churn" valve is usually wide open or closed tight. If such a system will work well, the change from domestic supply to fire supply could be made by simply closing the valve.

Yours truly, W. T.

July 6, 1894.

(A better arrangement would apparently be to provide a storage tank and run the pump intermittently, unless some condition not stated prevents this.—Ed.)

### AN ACCIDENT CAUSED BY A BURNED TRESTLE.

Sir: A mixed train on the Alabama Mineral Division of the Louisville & Nashville R. R., which left here this afternoon at 2 o'clock, ran into a burning trestle three miles north of this city and the result is total destruction by fire to two passenger cars, a baggage and express car and two freight cars. The only injuries received were by the engine driver and fireman, who jumped from the locomotive when it was on a high embankment. The train was made up of eight freight cars and the passenger equipment above referred to, and approached the trestle on a descending grade and a stiff curve from a deep cut. When the burning trestle came in sight brakes were applied, but owing to the near proximity of the trestle, it was impossible to avoid running onto it. The trestle was about 100 ft. long and 20 ft. high. The locomotive and six cars passed entirely over, but owing to the fact that the tender was derailed at some point on the trestle, one line of rails was ripped up and the six cars, which were kept on the trestle by the guard rails, on reaching the embankment, rolled down it, on the side of the displaced line of rails, thus breaking loose from the five cars behind and leaving them on and adjacent to the burning trestle. The locomotive remained on the track, and had its tender not been derailed, the momentum would have carried the train far beyond the trestle. The cause of the fire is supposed to be due to a spark from the locomotive of a train which passed over the trestle two hours previously. A number of passengers were aboard, and no difficulty was experienced in getting out, which was accomplished by passing through the train to the rear car, the rear trucks of which were on the embankment. The cars which passed over the trestle are scattered along the foot of the embankment a distance of perhaps 300 ft., some detached and lying apart, while others are piled on each other, the whole presenting a scene of total destruction. Very truly, Wm. E. Robertson,

Anniston, Ala., July 2, 1894.

### NOTES AND QUERIES.

H. H. asks: "Which will produce most heat, to burn a given volume of gas issuing in a jet or a burner, or to consume the same amount by exploding it, as in the cylinder of a gas engine, for example?" If we suppose that perfect combustion takes place, the total energy produced will be the same in each case, but a small percentage of the heat will be converted into mechanical work if burned explosively, so that the actual resultant heat would be slightly less.

**An elastic method of interpreting specifications is described as follows by the Los Angeles "Times":**

Two or three contractors and others were standing together in the City Hall corridor yesterday when one of them told of a new method of complying with specifications as to the broken stone used in paving a street. On a certain street, so the story went, the specifications for the work required that the broken stone should be of such a small size that any piece would pass through a 2-in. ring. Some one observed that some of the stones used were nearly as large as a man's head and called the contractor's attention to the discrepancy between the actual size and the specified size. The contractor said the stones were all broken small enough to comply with specifications and promptly proved the statement by taking one of the largest stones and, after pulling from his pocket a 2-in. rubber ring, stretching the ring to a sufficient size so that the stone could be passed through it with the greatest ease.

## WATER SUPPLY, POWER AND ELECTRIC WORKS OF ZURICH, SWITZERLAND.

(With inset.)

The largest city in Switzerland is Zurich, which now has a population of about 100,000. A water supply and power plant, combined with an electric plant for light and power, is owned and operated by the city, and has many points of interest, including an elaborate and costly water filtration system, consisting of covered filter beds of sand and gravel. This combined plant has been described at length by Mr. C. S. Du Riche Preller, Assoc. M. Inst. C. E., in a paper before the Institution of Civil Engineers,* from which the greater part of the following description has been taken, and from the illustrations of which the accompanying inset was reproduced. The two views in the text and some more recent information regarding filtration at Zurich were contributed to this journal by Prof. Wm. P. Mason, of the Rensselaer Polytechnic Institute, Troy, N. Y., who recently visited the Zurich plant.

The material for Mr. Preller's paper was secured during a personal visit to Zurich in 1891, in connection with a tour of inspection of the waterworks of the principal Swiss towns.

The original water supply of Zurich appears to have been from springs, the pipe system heading at the point shown in Fig. 1 on the inset. In 1861 this supply was supplemented by water from the River Limmat, taken 3,135 ft. from the point where the river emerges from Lake Zurich. The supply provided in 1861 was on the basis of about 50 U. S. gallons per capita. In 1871 a submerged sand filter bed, with an area of 12,240 sq. ft., was built in the river 825 ft. below the lake, as shown in Fig. 1. A 23.6-in. concrete conduit was used to convey the filtered water to the pumping station, and this conduit was subsequently extended in two stages, until it reached the present pumping station, shown in Fig. 1, built in 1878, the last 3,630 ft. of the conduit being of cast iron. Water power has been used for pumping from the start, supplemented later on by steam power for emergency use.

In the spring of 1884 an epidemic of typhoid fever attacked the city, and fully 2% of the population had the disease, 9% of the cases proving fatal. An investigation led to the conclusion that dredging operations for quays had caused impurities from the river bottom to pass onto and through the submerged filter, and further, that the concrete conduit, although laid from 6 to 10 ft. below the river bottom, had admitted polluted water. Cast iron pipe was substituted for the concrete conduit, and it was finally decided to secure a new supply from Lake Zurich, the natural waters of which, as well as the River Limmat, had always been considered of excellent quality. The springs were yielding a maximum of 800,000 and a minimum of 225,000 gallons per day, and their use was to be continued. The river supply was to be used through the old conduit for the supply of motive power.

Lake Zurich has a drainage area of 423 sq. miles, and a surface area of 34 sq. miles. It lies at an altitude of 1,342 ft. The mean depth of the lake is 230 ft., and the maximum depth 466 ft. The average rainfall at Zurich from 1864 to 1883, inclusive, was 45.48 ins., and the mean discharge of the lake is 2,132,000,000 gallons per day. Before reaching Lake Zurich the Alpine waters which feed it pass through Wallen Lake, which has an area of 9 sq. miles, a mean depth of 492 ft. and an elevation 46 ft. greater than Lake Zurich. Each of these lakes aids greatly in the purification of the water, as is evinced by the matter deposited on the lake bottoms. The water has a slow motion through the lakes, and has a large area exposed to the sun and wind.

The intake at the head of the present supply conduit is shown by Fig. 2, and also in plan on the map, Fig. 1. It is located 919 ft. from the nearest quay, at a point where the water is ordinarily 56 ft. deep. Originally water was drawn from a point 13 ft. below ordinary water level, but to secure water at as low temperature as possible the intake mouth was lowered to within 10 ft. of the bottom, or 46 ft. below the surface. The quality of

*Proc. Inst. C. E., vol. CXI., session 1892-93, Part I.

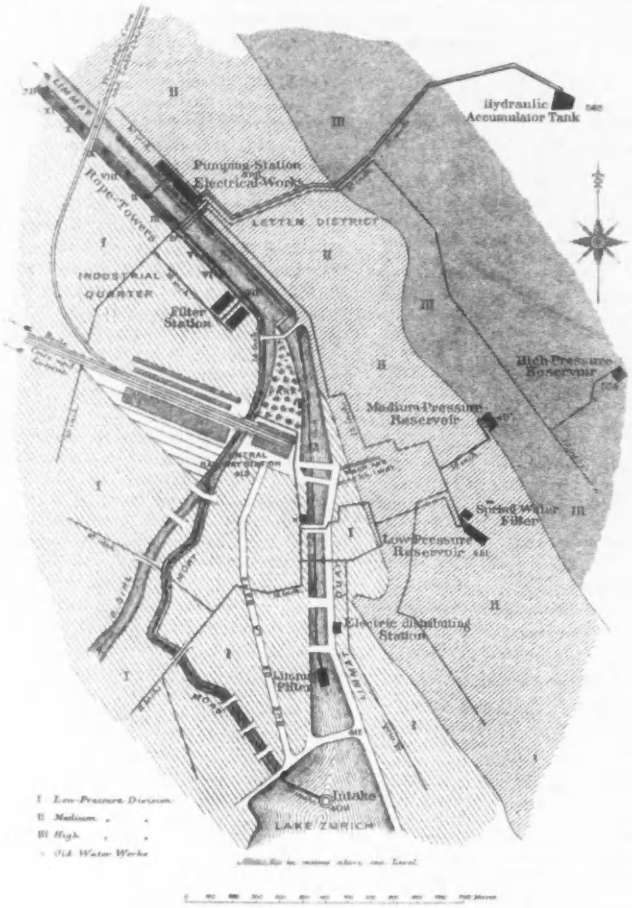



FIG. 1. GENERAL PLAN OF WATER-WORKS SYSTEM.

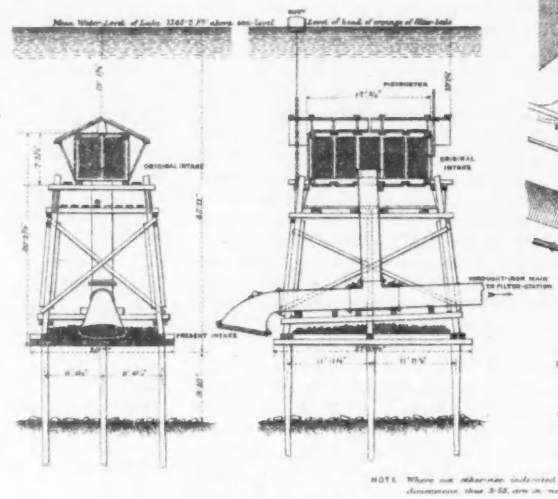



FIG. 2 LAKE ZURICH INTAKE.

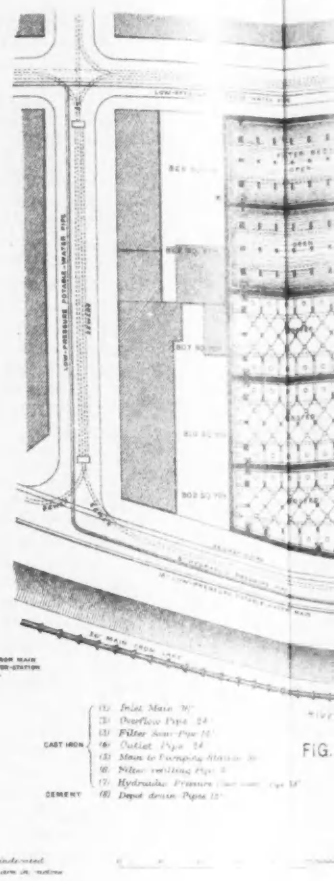



FIG.

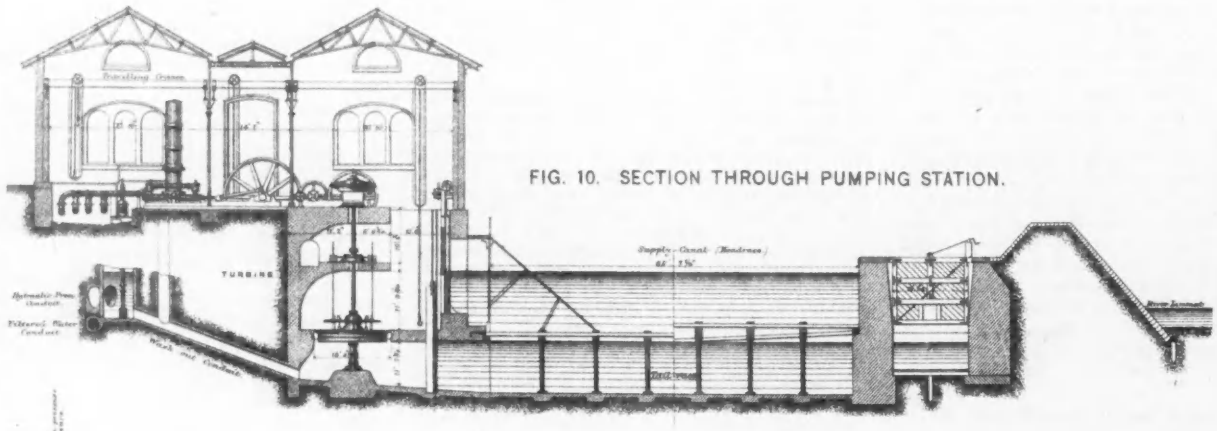
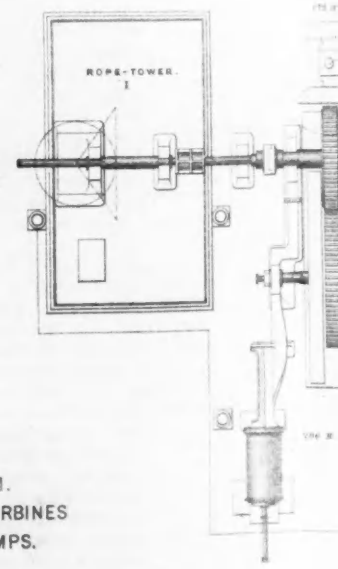



FIG. 10. SECTION THROUGH PUMPING STATION.



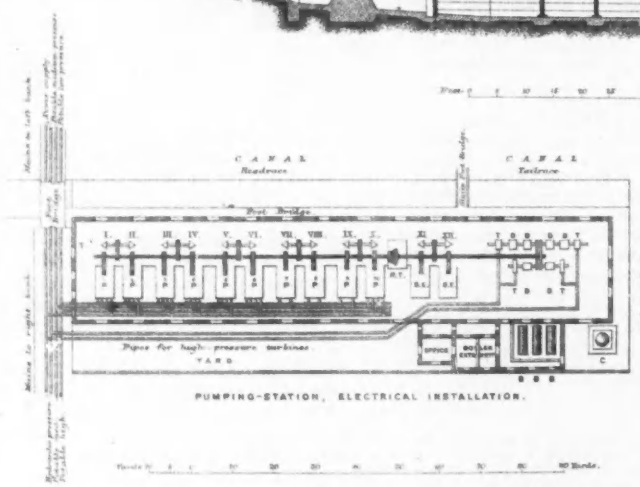




FIG. 9. GENERAL PLAN OF PUMPING AND ELECTRIC STATION.

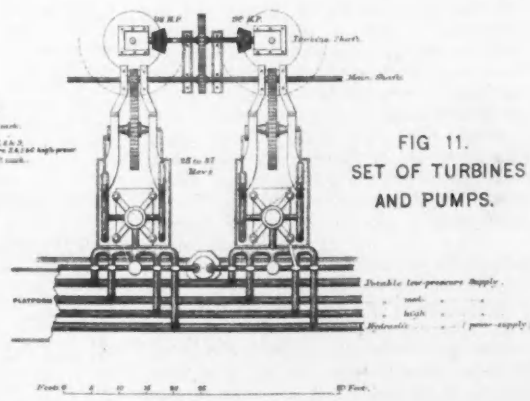



FIG 11.
SET OF TURBINES
AND PUMPS.

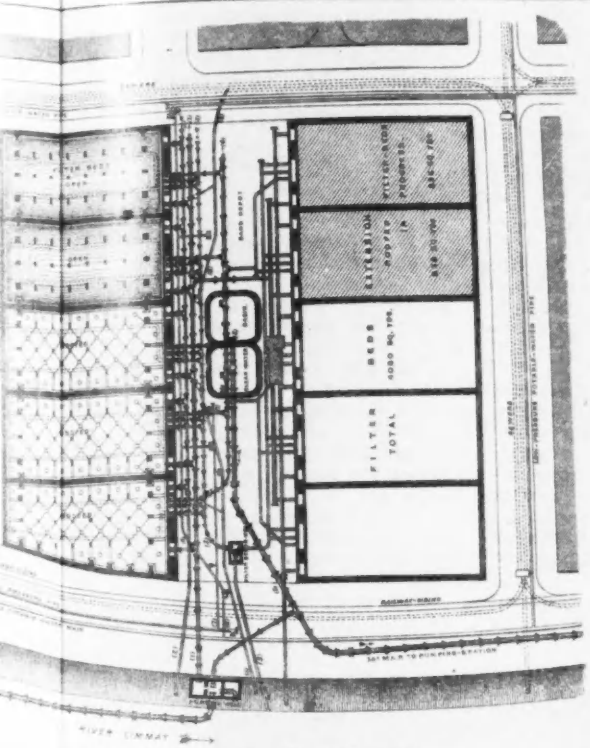



FIG. 3. GENERAL PLAN, FILTER BEDS.

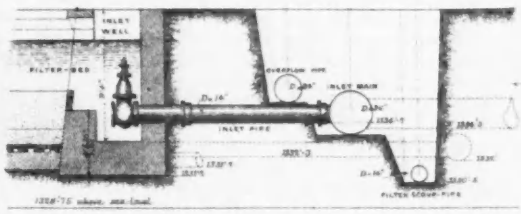



FIG. 7. SECTION THROUGH INLET WELL AT E-F.

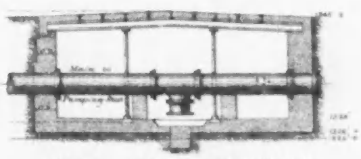


FIG. 8. SECTION THROUGH CLEAR WATER BASIN AT G-H.

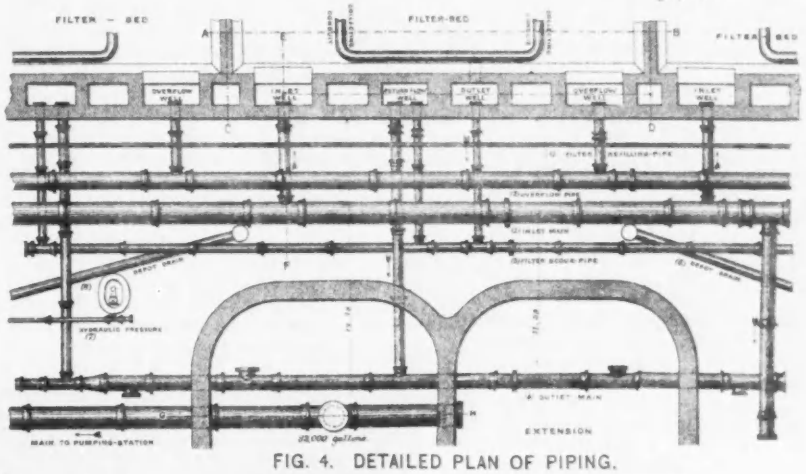



FIG. 4. DETAILED PLAN OF PIPING.

FIG. 5. SECTION THROUGH FILTER BED AT A-B.

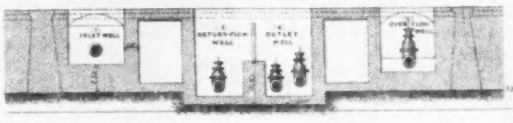



FIG. 6. SECTION THROUGH INLET AND OUTLET WELLS AT C-D.

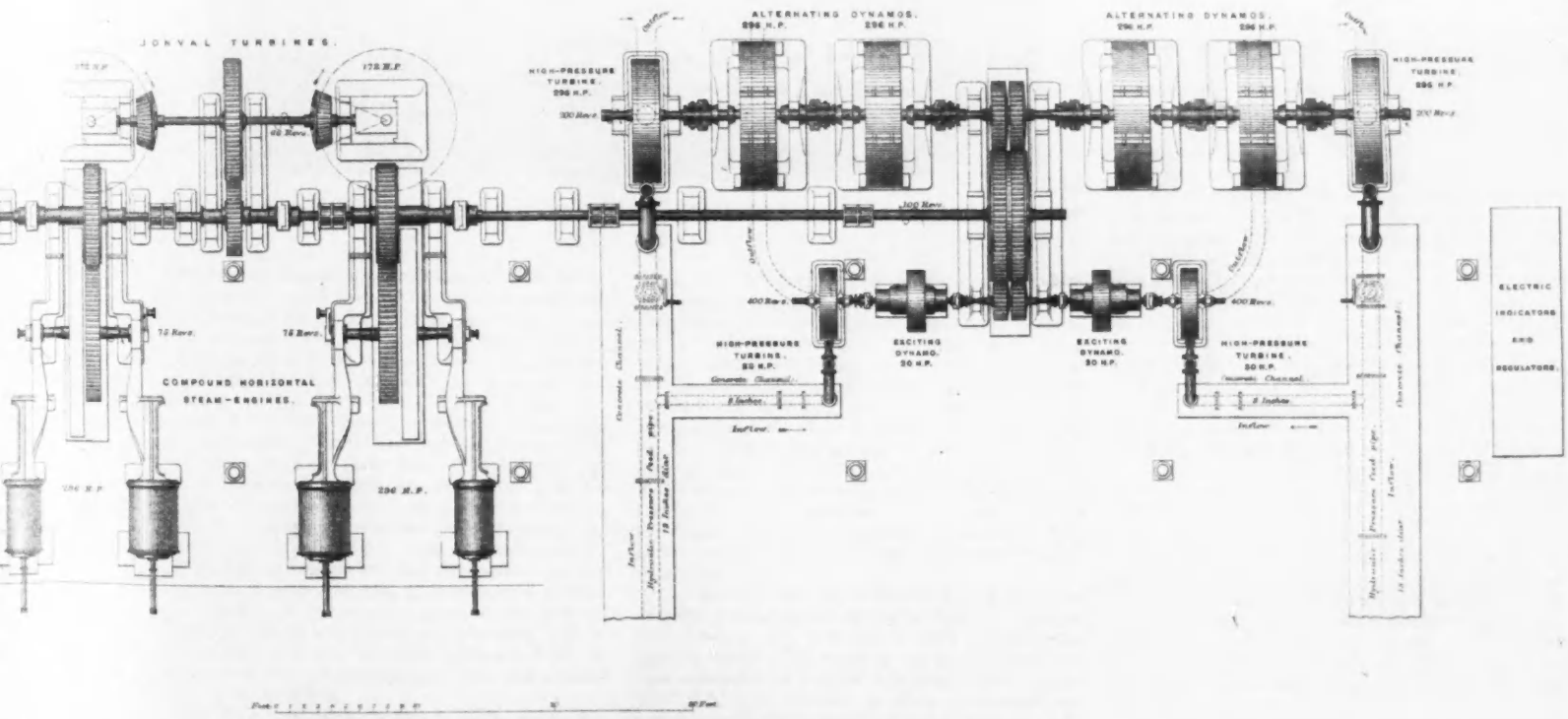



FIG. 12. ENLARGED PLAN OF STEAM AND ELECTRICAL INSTALLATION.

ELECTRIC WORKS OF ZURICH, SWITZERLAND.

CHAS. HART & SONS, LITH., 26 VESEY ST., N. Y.

the water at this depth was equal to that 13 ft. below the surface, but lower yet the material at the bottom of the lake impaired its quality. The relative temperatures at different depths, as shown by almost daily observations in 1886, 1887 and 1888, were as follows:

| | | Degrees Fahrenheit. | | | |
|---|---|---|---|---|---|
| Depths, ft. | | 13 | 39 | 46 | 45 |
| Temperature, | minimum | 36.7 | 37.0 | 37.2 | 37.2 |
| " | maximum | 63.2 | 56.8 | 52.9 | 48.9 |
| " | mean | 49.8 | 46.2 | 44.8 | 43.3 |

The mean temperature of the water as distributed is from 48 to 50° F.

The intake pipe within the lake rests on a pile trestle. From the intake to the pumping station is a distance of 10,893 ft., of which the first 1,053 ft. is of 35-in. wrought iron pipe, terminating at the moat. The remainder is cast iron pipe, for the most part 36 ins. in diameter.

The location of the filter beds is shown in Fig. 1, and their details by the plans and sections, Figs. 3 to 8, inclusive. There are now in use seven beds, all covered. Originally only five beds were built, three covered and two open, as shown in the plan, Fig. 3, but two new covered beds have been added, and the two old beds have been covered, while more beds were being constructed last winter. The effective area of each bed is 7,290 sq. ft., giving for the five original beds an area of 36,450 sq. ft., and for the seven 51,030 sq. ft

The floor of the beds is at an average of 10 ft. below the ground surface, 19,097 cu. yds. of material having been removed and used to form pleasure grounds at the lake. The partition walls are 4 ft. 5 ins. thick at the footings, and 1 ft. 10 ins. at the copings. The floor is 14 ins. thick, with an inclination of 1 in 40 in the direction of the two drain pipes in each bed. All the masonry construction is of a heavy and costly character, consisting of Portland cement concrete in proportions of 1 part cement, 3 sand and 6 gravel for the walls and floors, with 2 parts less of gravel for the arches. All wet surfaces are lined with 1 in. of mortar, 1 part cement to 3 parts sand, over which is a thin coating of cement powder, the whole faced, after setting, with a "skin of cement-milk."

The beds, or at least the first five, are covered by 8-in. groined arches of 14¾ ft. span, and 4 ft. 1 in. rise, resting on 24 concrete piers of an average height of 11½ ft. and a mean cross-section of 2 ft. 11 ins. × 2 ft. 3 ins. Circular openings, 2 ft. 11 ins. in diameter, are provided for light and ventilation, 36 for each bed.

The filter and drainage bed is made up as follows: Two alternate layers of brick with spaces between are laid on the floors of the filters, between and above which is a layer of coarse gravel 6 ins. thick, supporting 4 ins. of fine gravel, 6 ins. of coarse sand and finally 32 ins. of fine sand, which serves as the filtering medium.

The sand for the filters was obtained at the upper end of the lake, and after an experiment with manual labor, was sorted and washed in a machine driven by a hydraulic motor, the saving effected by the machine being 33⅓%. The cost of preparing the sand (apparently including the gravel used) is given as about 17.5 cts. per cu. yd., one machine handling 39 cu. yds. per day.

The filters are operated under a normal head of about 39 ins., the water level being about 27½ ins. below the coping stones, which are on a level with the ordinary lake surface.

Filtered water passes from the collecting drains to a return flow well, from which it passes to the outflow well through a sluice valve, designed to regulate the rate of filtration. These wells, together with the inflow and overflow wells, are placed in the front wall of the beds, as shown in Figs. 4, 6 and 7. A filter sump is placed between the two series of beds, as shown in the plan, Fig. 1, for use in draining the beds by pumping in times of flood, when discharge into the river is impossible. The piping system for the filters is shown in plan in Figs. 1 and 4, and with the five beds in use included 3,252 ft. of pipe of various sizes, with 43 T-branches and 33 stop valves.

The clear-water basin located beneath the sand depot, between the two series of beds, has a capacity of about 100,000 U. S. gallons. A second one was proposed when Mr. Preller's paper was written. The basin is covered and is built of concrete.

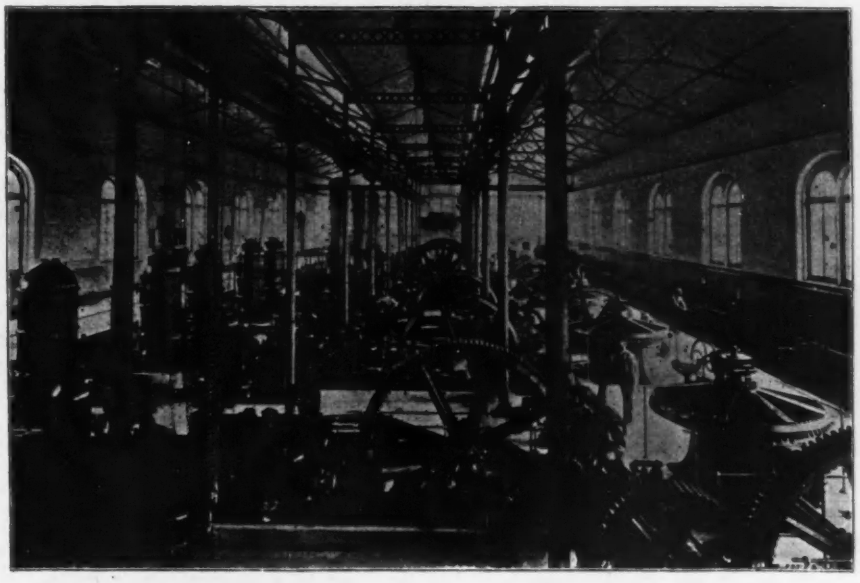


FIG. 13. INTERIOR VIEW OF ZURICH PUMPING AND ELECTRIC STATION.

The cost of the filtration works complete, with all accessories, was about $110,000 for the five beds only, three covered and two open. This sum includes $23,000 allowed for the land used, which was already owned by the city. The cost of the three covered beds, including only the masonry and filtering material, was about $36,000, and of the two open beds about $16,000, or about $1.65 per sq. ft. of filtering surface for the covered and $1.10 for the open beds. The cost per square foot of available area for the beds and all accessories cannot be given with fairness until the proposed beds are completed, since the item for the five beds, given above, includes land and some accessories for the completed plant.

The relative cost of construction and operation and the general manipulation of the three covered and two open beds is shown in detail by the accompanying table. The items of cost in the table have been reduced to a basis of dollars and cents, square feet and U. S. gallons, in place of pounds and pence, square yards and imperial gallons, as originally presented.

The average rate of filtration, prior to the writing of Mr. Preller's paper, ranged from about 150 to 240 U. S. gallons per sq. ft. per day, or from 6,500,000 to 10,450,000 gallons per acre. Investigation to determine the efficiency of filtration at varying rates have been made at Zurich, the average of some 300 examinations being as follows:

(Parts per 100,000.)

| | | | | | |
|---|---|---|---|---|---|
| Rate of filtration, gallons per sq. ft., up to | 100 | 120 | 200 | 373 | 493 |
| Rate of filtration, million gallons per acre, up to | 4.36 | 5.23 | 8.71 | 16.25 | 21.48 |
| Organic mat'r | 1.65 | 1.69 | 1.7 | 1.7 | 2.02 |
| Ammonia: | | | | | |
| Free | 0.0007 | 0.0008 | 0.0004 | 0.0004 | 0.0006 |
| Albuminoid | 0.0028 | 0.0027 | 0.0027 | 0.0027 | 0.0037 |
| Bacteria, per cu. cm. | 20 | 31 | 22 | 15 | 18 |

Mr. Preller concludes from the above figures that with the beds in proper order "neither the chemical nor the bacteriological purity of the filtered water is impaired" by increasing the rate of filtration from 136 to 373 gallons per sq. ft., or from about 6,000,000 to 16,000,000 gallons per acre, but without knowing more about the experiments such conclusion should be received with caution, especially as 2,500,000 gallons per acre is generally considered as the maximum safe limit where bacteria are to be removed.

If we knew in each case the character of the water before filtration and the percentage of impurities removed a better opinion could be formed of the results at various rates of filtration than can be formed from the character of the filtrate alone. While these figures are not all given for the experiments, they are presented as showing the results of filtration in 1889, when the average organic matter was reduced from 1.82 to 1.45 parts per 100,000, or 20%, the albuminoid ammonia from 0.0034 to 0.0020, a reduction of 40%, and the bacteria were reduced 90%, or from 175 to 17 per cu. cm. That something is wrong in the operation of the filters or elsewhere in the water-works system is indicated by an incresae in both the organic matter and the bacteria between the time of filtration and delivery to consumers. The bacterial results for the four years, 1886 to 1889 inclusive, were as follows:

(Bacteria per cubic centimeter.)

| | Before filtration. | After filtration. | At distribution. | Per cent. reduction at— Filters. | Taps. |
|---|---|---|---|---|---|
| 1886 | 178 | 25 | 27 | 86 | 85 |
| 1887 | 239 | 18 | 39 | 93 | 84 |
| 1888 | 188 | 19 | 29 | 90 | 85 |
| 1889 | 175 | 17 | 27 | 90 | 85 |
| Average | 195 | 20 | 31 | 90 | 85 |

It would appear from the above that sufficient organic matter remains in the filtrate to afford food for the further development of bacterial life, but possibly there may be some other cause for this growth.

The loss of head in each filter is measured three times a day, and the beds are cleaned when the difference between the level of the unfiltered and the clear water ranges from 24 to 32 ins. In cleaning about ¾ in. of the sand layer is scraped off with spades. When the sand is reduced from 32 to 12 ins. in thickness it is replenished, or the whole bed is renewed, after which the bed is refilled from below with filtered water and the filtrate wasted until the water is fit for use, which requires from 11 to 20 days in the case of complete renewal.

The desirability of allowing the filtrate to run to waste after cleaning is shown by the results at Altona, near Hamburg, Germany, where examinations of water from four beds before and after cleaning, gave the following numbers of bacteria:

| | Bacteria per cu. cm.. Before cleaning. | Next day. |
|---|---|---|
| Filter No. 2 | 14 | 246 |
| " " 4 | 24 | 54 |
| " " 5 | 24 | 158 |
| " " 7 | 38 | 288 |

These figures were furnished by Professor Mason, who states as a further example of the care needed in watching each bed of a filtration system instead of relying upon the combined effluent that at one time the water from the whole Altona plant showed 154 bacteria per cu. cm., while that from Bed No. 8 was delivering water containing 832 bacteria.

Water for power is taken from the River Limmat through a canal which gives varying heads, volumes and available power at different seasons, as follows:

| | Fall, ft. | Volume, cu. ft. per sec. | Equivalent, HP. |
|---|---|---|---|
| Summer, high water | 4.92 | 2,295 | 1,300 |
| " mean water | 8.20 | 1,660 | 1,570 |
| Winter, low water | 10.50 | 1,059 | 1,280 |

At 80% efficiency of the absolute power, the mean effective power is 1,100 HP. This is utilized as follows:

| | HP. |
|---|---|
| Pumping the potable water supply | 237 |
| Hydraulic pressure | 128 |
| Rope transmission | 227 |
| Electric lighting | 444 |
| Total | 1,036 |

Two 296-HP. steam engines are provided for reserve.

The pumps are driven by ten Jonval reaction turbines, power from which is transmitted from the vertical shaft by bevel-gearing to horizontal shafts, thence by pinions to a main shaft of steel, 7.6 ins., making 100 revs. per minute. This shaft is 328 ft. long, and passes through the whole length of the station, so that the whole of the turbine, pumping, steam and electric machinery may be coupled to it separately or collectively. The collective effective power of the ten turbines is 1,130 HP., and their combined cost was about $60,000. At the time Mr. Preller's paper was written there were in use seven horizontal compound Girard pumps, with a combined capacity of nearly 10,000,000 gallons per day. These pumps and accessories cost a total of about $75,000. Both the turbines and pumps were supplied by Escher, Wyss & Co., of Zurich. A plan of the power and electric station is shown by Fig. 9, a section through the station by Fig. 10, and one of the sets of pumps by Fig. 11, while Fig. 13, in the text, is an interior view of the station.

Generally the filtered water is pumped direct to the consumers, the surplus going to three covered reservoirs. The river water from the old conduit is pumped to an open tank. The mean lift to each of the four reservoirs, length and diameter of force mains and capacity of the reservoirs are as follows:

| Reservoir. | Mean lift, ft. | Force main, Length, ft. | Diam., ins. | Capacity, U. S. gals. |
|---|---|---|---|---|
| Low | 230 | 8,858 | 12.16 | 1,500,000 |
| Middle | 374 | 7,874 | 10.18 | 500,000 |
| High | 528 | 9,186 | 8.10 | 80,000 |
| Hydraulic | 554 | 5,577 | 18.00 | 2,500,000 |

The cost of the three first reservoirs was over $60,000.

There were in the distribution system 72 miles of 16 to 1.6-in. pipe, 752 valves and 1,294 hydrants, the latter being placed 198 ft. apart and close to the edge of the curb. Pipe is laid 5 ft. below the surface of the ground. The total cost of the distributing system was nearly $200,000. The number of typhoid cases in 1891 was 90% less than in 1880, when the river water was used. The average charge for potable water is given at 7 cts. per 1,000 gallons.

Of a daily supply of 61.2 gallons per capita 56% is used for "potable and domestic" purposes, 14% for industrial purposes, 14% for small motors and 6% for public purposes. The yearly increase in consumption of filtered lake water in the five years ending with 1890 was 6%, against an increase in total population of only 2%, but in this period the population actually served increased from 76 to 86% of the total population of the city.

Motive power for industrial purposes is supplied by wire rope transmission, by hydraulic pressure and by small motors driven by means of filtered water. The two former systems are chiefly used in the industrial quarter, near the filter station, as shown in Fig. 1. Here the city owns about 50 acres of land, which it rents for about 25 cts. per sq. yd., in order to dispose of its surplus power.

By means of rope towers, shown in Fig. 1, power is supplied to a flour and a silk mill, a dye house and a machine shop. The velocity of the rope is 65.6 ft. per second. The total power supplied is 227 mean and 246 max. HP. at the main shaft. The receipts are about $29 per HP.

Water from the hydraulic tanks drives small turbines for various industrial works, the receipts averaging slightly over 2 cts. per 1,000 gallons of water pumped, and the charges ranging from about 1.2 to 2.5 cts. per HP.-hour.

About 180 small motors, ½ HP. and upwards, aggregating 187 HP., are driven by potable water and yield a revenue of about 9 cts. per HP.-hour.

The electric installation at the power station is shown in plan by Figs. 9 and 12.

The generators are driven by two high-pressure and two reaction turbines, two 300-HP. steam engines being held in reserve. The large high-pressure turbines and two 30-HP. high-pressure turbines for the exciters are driven from 444 HP. available high-pressure water power, accumulated to 735 HP. by storage in the hydraulic tank during the day. The two reaction turbines are driven by power from the river.

As the main shaft in the station makes but 100 revolutions per minute and the dynamos 200, a separate shaft for the high-pressure turbines and dynamos is placed 5¼ ft. from the main shaft. Additional power from the main shaft is transmitted by gearing of 1 to 3. By means of friction couplings the dynamo shaft may be worked in three parts, one or two driven for night service by accumulated tank power through the high-pressure turbines, and one for day service, driven from the main shaft.

There are four alternators, each giving, at 200 revolutions per minute, 100 amperes at 2,000 volts, or a total of 800,000 watts.

The cost of an installation designed for 10,000 60-watt incandescent and 130 900-watt arc lamps, including the electric machinery and distribution, but excluding the building, hydraulic machinery and engines detailed to water-works, was about $235,000. The total annual expenditure, including interest and sinking fund, is $58,440, divided $16,948 for the 130 arcs (235,600 hours) and $41,492 for the 10,000 incandescents (5,000,000 hours), making an expense of about 7.2 cts. per arc and 0.8 ct. per incandescent lamp hour. The rates charged for private incandescent lighting were fixed at a mean of 1.2 cts. per lamp-hour for 1,000 hours, exclusive of the first cost of lamp and fittings and renewals, but including a fixed meter charge of about 185 cts. per year. The rates charged return a net surplus above cost of operation, interest and sinking fund of nearly $13,000.

Relative Cost and General Operation of Roofed and Open Filter Beds.

| Cost of construction per sq. ft. of filtering surface. | Three roofed beds. | Two open beds. |
|---|---|---|
| Land, intake and mains | $2.93 | $2.93 |
| Beds and wells | 1.65 | 1.06 |
| Conduits, outer wells and sand depot | .47 | .47 |
| ..... | $5.27 | $4.46 |
| Cost of operation per 1,000,000 U. S. gallons filtered. | | |
| Superintendence | $0.15 | $0.19 |
| Cleansing and replenishing sand | 0.16 | 0.28 |
| Breaking ice | .... | 0.03 |
| Renewing filtering material | 0.17 | 0.31 |
| Maintenance, intake and mains | 0.08 | 0.09 |
| Repairs and sundries | 0.03 | 0.04 |
| Total | $0.59 | $0.94 |
| 6% interest and sinking fund | 5.47 | 5.79 |
| Grand total | $6.06 | $6.73 |
| General operation of beds. | | |
| Total filtering surface, sq. ft. | 21,600 | 14,967 |
| Average yield, U. S. galls. per day per sq. ft | 180 | 150 |
| Average yield, U. S. galls. per day per acre | 7,800,000 | 6,500,000 |
| Filter material renewed after months | 40 | 29 |
| Renewing requires, exclusive of wasting, days | 30 | 35 |
| Filtrate must waste after cleaning, days | 11 | 20 |
| Total renewal period, days | 41 | 55 |

## LEGAL DECISIONS OF INTEREST TO ENGINEERS.

### Adjustment of Deficiences in Surveys of Public Lands.

On an appeal from a survey, appearing and asking the decision of the Circuit Court on an agreed statement of facts waives absence from the record of notice of time of survey and informality in the record of the survey. Where one owned the south half, and another the north half, of a northwest quarter section. By the original survey and plat of the surveyor general, the east line of the quarter was 38.05 chains, and the west line 38.48 chains; and, while the quarter line was not established, the plat assigned 20 chains to the east and west lines of the quarter at the south end, and 18.05 chains to the east line, and 18.48 chains to the west line, at the north end. The east and west lines of the quarter were, in fact, only 37 chains, so that the quarter contained 6.49 acres less than shown by the plat. The plat marked the south portion of the quarter as containing 80 acres, and the north as containing 72.49 acres, and the patents and subsequent conveyances so described the tracts. The deficiency should be deducted proportionally from the north and south half quarters on the basis of 80 and 72.49 acres, respectively, since the rule applied to original surveys, that the interior lots in fractional sections shall be made to contain the legal number of acres and that any deficiency shall be charged against the outer lot, does not apply when the original surveys are found to be erroneous.—Caylor v. Luzadder (Supr. Ct. of Ind.), 36 N. T. Rep., 900.

### Liability of City for Water-Works Bonds.

Though the purchase or erection of water-works be a matter within the discretion of the city council, yet equity will, at the suit of taxpayers, restrain their purchase, for $28,000, of water-works worth only $10,000, and inadequate and unsuited to the purpose.—Avery v. Job (Supr. Ct. of Ore.), 36 Pac. Rep., 207.

### Liability for Negligence of Contractor.

A company which obtains leave to dig up streets and lay its pipes along them is liable for personal injuries caused by the defective filling of a trench, even though the work was being done by and under the exclusive control of another, who had contracted to do the work for the company.—Colgrove v. Smith (Supr. Ct. of Cal.), 36 Pac. Rep., 411.

### Franchise Involving Pipe Laying.

One who obtains a franchise from a city, which necessitates the laying of pipes in the streets, takes the same subject to delay or refusal on the part of the Common Council in which is vested the control of the streets to grant a permit to lay such pipes.—Mayor et al. vs. N. Y. Refrig. Cons. Co. (Sup. Ct. of N. Y., Special Term, N. Y. Co.), 26 N. Y. Supp., 614.

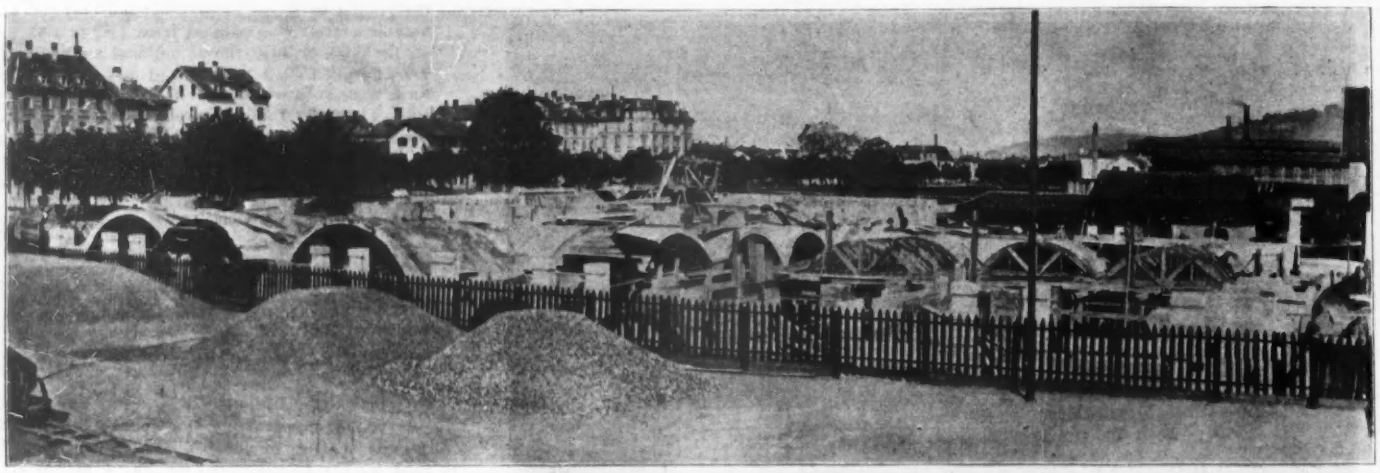
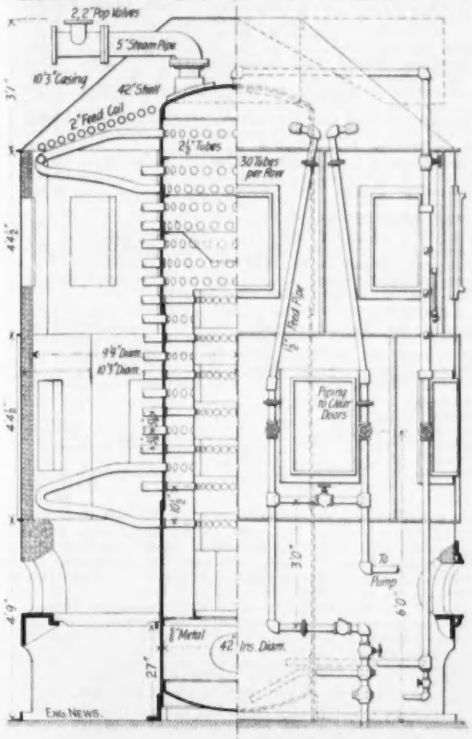


FIG. 14. COVERED FILTER BEDS UNDER CONSTRUCTION AT ZURICH.

## THE CLIMAX STEAM BOILER.

We show herewith working drawings of a steam boiler of interesting design, which appears to be coming into extensive use, and is claimed to possess numerous advantages, especially for high pressures,




Climax Steam Boiler of 200 HP.

over water-tube boilers of the common type. As seen by the accompanying drawings, the boiler has a central shell, from which extend loop tubes having both ends opening into the shell. the tubes being bent spirally and having one end at a higher level than the other. To aid in the circulation, an interior cylinder is placed inside the main shell, dividing it into two chambers. Into the central chamber the mixed steam and water from the bent tubes is delivered, short tubes being inserted in the upper end of each bent tube and extending across the annular space to a connection with the interior chamber. The nest of bent tubes is inclosed by an outer shell with a refractory lining, the shell having doors for cleaning purposes.

An important advantage of these boilers is that, like all vertical boilers, they occupy a very small amount of floor space in proportion to their capacity, and also save the expense of the brick setting ordinarily used with horizontal boilers.

The Climax boiler was first placed upon the market in 1889, and over 120 are now in use. The boiler plant at the World's Columbian Exposition included two Climax boilers of 500 HP. and one of 1,000 HP. The large boiler was 15 ft. 8 ins. diameter, 37 ft. high, shell 4 ft. 8 ins. diameter, with 1,000 tubes 12 ft. long and 3 ins. diameter. It is claimed to have the largest steam-making capacity of any single boiler ever constructed. These boilers are made by the Clonbrock Steam Boiler Works, Brooklyn, N. Y.

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An appropriation of $750,000 for extensions to the Brooklyn water supply is recommended by an aldermanic committee of that city. The money is to be the first appropriation toward a desired increase of 25,000,000 gallons daily to the supply, and will be expended, it appears, for additional wells and pumping stations.

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The expenditure of $7,500,000 for street and sewer improvements in the District of Columbia is contemplated in a bill now before Congress. The amount to be expended for trunk sewers is limited by the bill to $1,000,000, and for sewage disposal and protection against floods to $3,350,000, the latter work to be done in accordance with the plans recommended by Messrs. Rudolph Hering, Samuel M. Gray, and Frederic P. Stearns, constituting a board of sanitary engineers, appointed in 1890. This report was noted in our issue of July 26, 1890, and was abstracted at length in the issue of May 12, 1892. The plan in brief was to construct intercepting sewers to carry practically all the sewage to a deep water outlet, to put in storm water sewers to drain the low district and intercept the drainage from higher elevations, and to provide pumps for lifting the sewage at all times and the storm water from the low district at times of unusually high water. The total estimated cost was $3,600,000, with an annual pumping expense estimated at $20,000.

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The large storage and distributing reservoir at Buffalo, N. Y., described and illustrated in Engineering News of Jan. 10, 1891, was recently completed, water having been turned into the west basin Nov. 16, 1893, and into the east basin on July 6, 1894. The capacity of the basin is now given as 110,000,000 gallons, but its proposed capacity in 1891 was reported as 135,000,000 gallons. It is built in excavation and embankment, the latter without a heart-wall, and covers, with the embankments, about 22 acres. The cost of the reservoir is given at $465,000, against an estimate of $467,000. It has been under construction for five years, a change of contractors causing a delay. The reservoir was designed by the late Wm. J. McAlpine, and has been constructed by Mr. Louis H. Knapp, Chief Engineer of the Water-Works, with Mr. John Record as Assistant Engineer. The original contractors were O'Brien & Clark, of New York, who assigned the contract to Messrs. James W. Dwyer, of Worcester, Mass., and D. W. Huntington, of Rochester, N. Y.

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The sum which Kansas City, Mo., must pay for the works of the National Water-Works Co., which now supplies the city, has been fixed at $3,000,000. The difficulties between the city and the company have been before the courts for about five years, and the present decision, which is understood to be final, is by the U. S. Court of Appeals. The date of transfer is fixed as Dec. 1, 1894. Early in the year Messrs. Jas. Andrews and Robt. Moore, M. Am. Soc. C. E., as commissioners of the U. S. Circuit Court, appraised the works at $2,546,112, and the court fixed the price at $2,714,000. The $3,000,000 awarded just equals the bonded indebtedness of the company. The city wished to secure the works for $2,000,000, and the company asked $4,500,000 for them. The transfer of the Kansas City works to the city will leave only four, and practically but three, of the 25 largest cities in the United States supplied by private companies. The four cities are San Francisco, New Orleans, Louisville and Omaha. All but one or two shares of the Louisville company's stock is owned by the city. The city of New Orleans also owns quite a block of the stock of the local water company which supplies it. Portions of Chicago, Brooklyn, and Pittsburg are supplied by private companies; but except in the case of Pittsburg, the portions so supplied are very small. Eight of the works in the 20 cities named above as now owning their works were formerly owned by private companies, which shows that Kansas City is simply falling in line with the other large cities of the country in assuming ownership of its water supply system.

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The Metropolitan Elevated R. R. Co. of Chicago is said to have placed contracts for equipping its line, five miles in length, with electric motive power. At the start 55 motor cars will be put in service, each equipped with two 100-HP. motors. For the power house, engine and dynamos aggregating 6,000 HP. are planned. It is hoped to have the line in operation some time this fall.

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Competitive plans for the half-dozen buildings in which the Atlanta Exposition of 1895 is to be held are asked by the Cotton States and International Exposition Co., which has the enterprise in charge. The largest building is to be 300 × 430 ft. All competing plans are to be submitted by Aug. 15. Mr. Grant Wilkins, of Atlanta, is chairman of the committee on Buildings and Grounds.

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A "good roads" convention was held at Asbury Park, N. J., July 5 and 6, at which 40 states are said to have been represented, and there was an exhibition of road machinery. Mr. W. S. Bacot, M. Am. Soc. C. E., of New York, said in an address that an immense amount of labor was needlessly expended upon road construction, which was a constant drain upon taxpayers. The construction of the best highways on Long Island cost twice as much as for the same kind of roads on Staten Island, because the cost of transportation, in the first case, was enormous. Mr. George C. Perkins, of the Massachusetts State Board of Highway Commissioners, urged upon the delegates the necessity of organization, and emphasized the importance of ruling out party politics entirely in the appointment of highway officials. Resolutions were adopted, advising the organization of road leagues in states, the appointment by legislatures of Highway Commissioners, and instruction in highway engineering in colleges. The convention was addressed by Gen. Roy Stone, Engineer in Charge of the Road Inquiry Bureau under the U. S. Department of Agriculture. A permanent organization was effected and it was voted to hold an annual convention. Mr. Levi K. Fuller, M. Am. Soc. M. E., Governor of Vermont, was elected chairman of the executive committee.

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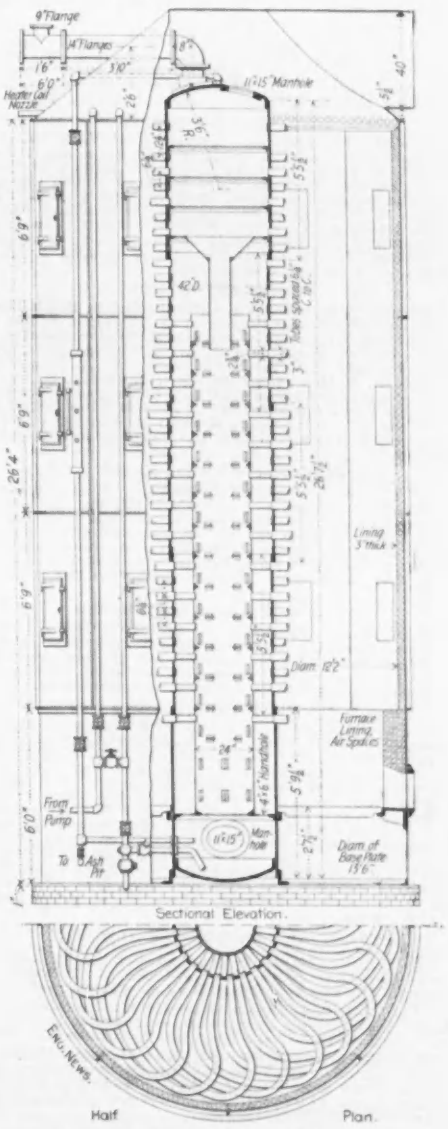
The topographical survey of New Orleans, made by Mr. L. W. Brown, City Engineer, to aid in studying the drainage question, has been completed, and a bill providing for the drainage of the city has passed one branch of the state legislature. The bill names Messrs. Albert Baldwin, R. M. Walmsley and J. C. Denis as a drainage board, with the Mayor as a member ex-officio. The three men named are members of the present advisory drainage board, mention of which was made in Engineering News of April 12, 1894. The bill gives the proposed board authority to select and carry out a plan for the drainage of the city, and places at its disposal the $700,000 recently received by the city from the sale of street railway franchises (as stated in our issue of Oct. 5, 1893), together with some other sources of revenue.

## CONSTRUCTION NEWS.

### RAILWAYS.

**East of Chicago.—Existing Roads.**

OTTAWA, ARNPRIOR & PARRY SOUND.—Geo A. Mountain, Ch. Engr., Ottawa, writes us that 1,500 men are at work on this Canadian road. Up to the present time 32 miles have been graded this season and 20 miles of track laid, and 35 miles more are now being graded, upon which it is expected that track will be laid by Nov. 1. This takes the road 140 miles from Ottawa. At the Parry Sound end, 10 miles are now being ballasted and 10 under construction, making




Climax Steam Boiler of 500 HP.

40 miles built at that end, and a total of 180 miles finished out of a projected 250 miles. J. R. Booth, Ottawa, is president, and E. I. Chamberlain, general manager.

WATERVALE & BENZIE.—It is stated that a company will be organized under the above name to operate the railway now being built by the Watervale Mfg. Co., Watervale, Mich., from Watervale to

Thompsonville, Mich., on the Chicago & Western Michigan and the Toledo, Ann Arbor & North Michigan. The road is reported as now completed to Smeizer, 6 miles.

WESTERN MARYLAND.—C. O. Vandervanter, Prin. Asst. Engr., Baltimore, writes us that between Jan. 1 and July 1, 1894, this company laid about 1,100 ft. of new track and has about 800 ft. more under contract, with the grading about completed. This is an extension of the main line from West York station eastward towards the projected main station in the city of York, all in the state of Pennsylvania. Contractor, J. H. Dobbling, National Hotel, York, Pa.

### Projects and Surveys.

BINGHAMTON & STATE LINE.—A. K. Harvey, Ch. Engr., Binghamton, N. Y., writes us that no subcontracts have yet been awarded for constructing this railway. The bids received by Erastus Ross, contractor, were considered too high to justify any awards just at present. The surveys for the line in Pennsylvania, incorporated as the Binghamton, Pennsylvania & Southern, were commenced July 9, at Monoghans, and will probably be made by way of Quaker Lake, Silver Lake, St. Josephs and down the middle branch of Wyalusing Creek.

COAST RY. OF NOVA SCOTIA.—Bids are being received, according to reports, for grading a portion of this railway. The line is projected from Yarmouth to Lockport, N. S., a distance of about 90 miles. A. H. Chadbourne, 29 Broadway, New York, is interested.

COBOURG,NORTHUMBERLAND & PACIFIC.—The Canadian government is reported to have granted this company a subsidy for the construction of a railway from Cobourg to Central Junction, Ont., on the Canadian Pacific, a distance of about 50 miles, and it is stated that arrangements are being made to construct the road. Ch. Engr., Henry K. Wickstead; Pres., Robt. Mulholland, both of Cobourg, Ont.

### Southern—Existing Roads.

ATLANTIC COAST LINE.—The last rail on the extension from near Sumter to Denmark, S. C., about 65 miles, was laid July 3. The line is laid with 70-lb. steel rails and has a maximum grade of 30 ft. and curvature of 2°, according to press reports.

### Projects and Surveys.

CANNELTON.—Incorporated at Cannelton, W. Va., June 31, with a capital stock of $5,000, by H. Davis, Cannelton; J. T. Lee, Philadelphia; J. F. Brown, M. Jackson and E. W. Knight, Charleston, W. Va.

### Northwest—Existing Roads.

FREMONT, ELKHORN & MISSOURI VALLEY.—It is stated that this company is building a line from Middle Creek stock yards, about two miles north of Belle Fourche, S. Dak., eight miles up Middle Creek, for the purpose of giving another loading yard for cattle. The survey is finished and the contracts have been let to A. T. Owen, of Norfolk, Neb. The line will have a maximum grade of 20 ft. and maximum curves of 2°, and is to be completed by Aug. 1. Ch. Engr., J. B. Berry, Omaha, Neb.

### Projects and Surveys.

WYOMING & DAKOTA.—Incorporated in South Dakota July 6 to build a railway from Minnesela, S. Dak., to Barrett, Wyo.; capital stock $500,000; incorporators, F. L. Underwood, Willard R. Green, Chicago; Geo. M. Nix, Dubuque, Ia.; A. A. Chouteau, W. A. Mitchell, Minnesela, S. Dak.; principal office, Minnesela, S. Dak. The proposed railway to the Hay Creek coal mines at Barrett, Wyo., was noted in our issue of June 28 as an extension of the Fremont, Elkhorn & Missouri Valley, with which it is stated that this company has no connection.

### Southwest—Existing Roads.

WYANDOTTE & SOUTHWESTERN.—J. H. Hamlen & Son, Little Rock, Ark., who are building this road to develop timber lands owned by the firm, have completed the line from Wyandotte, near Giffords, on the St. Louis, Iron Mountain & Southern, to Graham, Ark., a distance of about 12 miles, and it is stated that the road will be extended 12 miles further to Prattsville, Ark.

### Southwest—Projects and Surveys.

CALCASIEU, VERNON & SHREVEPORT.—Press reports state that Bentley Bros. & Co., New Orleans, have been awarded a contract for grading several miles of this projected railway in Louisiana, and that the construction will be commenced immediately.

### Rocky Mt. and Pacific—Existing Roads.

BUTTE, ANACONDA & PACIFIC.—Reports from Anaconda, Mont., state that it is certain that this railway will be built this season into Granite, Ravalli and Missoula counties in Montana, and that the construction will be commenced this month. The surveyors have been directed to finish the surveys to Missoula, which were begun last year. The railway is now in operation between Butte and Anaconda, 26 miles. The route agreed upon is stated as by way of Phillipsburg and down the Skalkaho River into the Bitter Root valley and thence to a point south of Missoula, where it will cross the Bitter Root River to reach the town of Missoula. Pres., W. L. Hoge, Anaconda, Mont.

## STREET AND ELECTRIC RAILWAYS.

LEWISTON, ME.—It is reported that N. O. Pope, New York, has purchased the Lewiston & Auburn Horse R. R. and will change it to an electric road.

HANOVER, MASS.—The Hanover St. Ry. Co., recently incorporated, is reported as planning to build an electric railway from this place to Rockland.

EAST STROUDSBURG, PA.—The Delaware Valley Electric Ry. Co. has been incorporated to construct a railway from this place to Milford and Matamoras; capital stock, $1,000,000; Pres., Ellicott Fisher, 343 South Front St., Philadelphia.

POTTSVILLE, PA.—The Schuylkill Electric Ry. Co. has decided to improve its road and purchase six new cars. Supt., W. H. Whildey.

WILMERDING, PA.—The council has granted a franchise to the Turtle Creek Valley Electric Ry. Co.

SANDERSVILLE, GA.—The construction of an electric railway from this place to Tennille is being agitated. Col. J. N. Gilmore is interested.

COLUMBUS, O.—A franchise has been granted to Forrester & Co., Cleveland, to construct an electric railway along the National road to Hebron and the Licking reservoir. It is reported probable that the line will be extended to Newark.

DEFIANCE, O.—The Defiance Light & Ry. Co. has been incorporated to supply gas, electricity and to operate an electric street railway; capital stock, $100,000; S. L. Nelson, Chas. E. Miley, A. S. Krotz, L. L. Miner and O. T. Martin.

WASHINGTON, IND.—A franchise has been granted to L. C. Fritch and W. N. McMahon to construct the Washington St. Ry., to be operated by electricity. The capital stock of the company is $50,000. Mr. Fritch, who is Engr. Miss. Div., Baltimore & Southwestern Ry., writes us that the line will be built at once.

SAGINAW, MICH.—The council has granted the street railway company permission to extend its lines to summer resorts down the river.

SHEBOYGAN, WIS.—The council has been petitioned by Chicago parties for a franchise for an electric street railway.

STEVENS POINT, WIS.—It is reported that the Stevens Point Lighting Co has petitioned for a franchise for an electric railway.

KANSAS CITY, KAN.—The Metropolitan St. Ry. Co. has petitioned for a franchise to extend its line.

DENVER, COLO.—The Traction Construction Co. has been incorporated with a capital stock of $50,000; incorporators, G. E. Hart, W. B. Doud, A. K. Kerkham.

## HIGHWAYS.

MASSACHUSETTS.—The board of selectmen of Nantucket has been authorized to make arrangements with the state highway commissioners for the construction of a road between that place and Siaconset, Nantucket county. An appropriation of $10,000 has been made with which to commence work, which it is expected will pay for building two miles.—A town meeting is to be held at Westfield, Hampden county, July 14 to vote on the question of authorizing the state highway commission to build the state road from West Springfield through that town, for which the state has appropriated $24,000.

PENNSYLVANIA.—The Laurel Run Turnpike Co. has been incorporated to construct a road along Laurel Run; capital stock, $10,000; Treas., C. W. Laycock, Kingston.

OHIO.—Bids are asked by the commissioners of Hamilton county, Cincinnati, until July 21 for improving Asburg road.—The commissioners of Hamilton county have received the following bids for paving Carthage Pike with brick:

| | |
|---|---|
| Estimated cost | $300,000 |
| John McDermott, limestone curb | 271,122 |
| " " granite curb | 283,040 |
| Huyman & Howal, limestone curb | 260,341 |
| " " " granite curb | 298,578 |
| Evan Evans & Co., limestone curb | 257,635 |
| " " " " granite curb | 294,880 |
| G. Eyerman & Co., limestone curb | 253,194 |
| " " " " granite curb | 282,900 |
| Kirchner & Folz, limestone curb | 261,195 |
| " " " granite curb | 287,024 |
| J. M. Peter, limestone curb | 269,478 |
| " " " granite curb | 305,233 |
| Branham & Gest, limestone curb | 283,846 |
| " " " granite curb | 321,091 |
| Pattison & Shipman, limestone curb | 255,027 |
| " " " granite curb | 285,823 |
| C. N. Danenhower, limestone curb | 257,611 |
| " " " granite curb | 291,380 |
| Henkle & Sullivan, limestone curb | 255,646 |
| " " " granite curb | 284,945 |

The bids received in April for this work were published in our issue of April 26.

INDIANA.—Bids are asked until July 14 for constructing 68,630 ft. of gravel roads in Grant county; estimated cost about $28,000. S. P. Barley, Engr., Marion.

MICHIGAN.—The residents of Chippewa county have voted to adopt the county road system.

## BRIDGES AND TUNNELS.

ALBANY, N. Y.—Bids are asked until July 19 for constructing a highway bridge over Buttermilk Creek; also for bridge repairs. Edward Hannan, Supt. Pub. Wks.

BROOKLYN, N. Y.—The Secretary of War has requested that plans be submitted by the county supervisors within 30 days for the reconstruction of the Vernon Ave. bridge over Newtown Creek.

WILLIAMSPORT, PA.—The contract for rebuilding the Market St. bridge, five spans, has been awarded by the county commissioners to the Groton Bridge Co., at $38,830, the bids being reported as follows:

| | |
|---|---|
| Edgemoor Bridge Co., Edgemoor, Del. | $34,300 |
| Massillon Bridge Co., Massillon, O. | 37,000 |
| Variety Iron Wks. Co., Cleveland, O. | 38,738 |
| Groton Bridge Co., Groton, N. Y. | 38,830 |
| Owego Bridge Co., Owego, N. Y. | 39,450 |
| Nelson & Buchanan Chambersburg, Pa. | 39,900 |
| Phoenix Bridge Co., Phoenixville | 44,870 |
| Bracket Bridge Co., Cincinnati, O. | 44,850 |
| Horseheads Bridge Co., Horseheads, N. Y. | 45,000 |
| Berlin Bridge Co., East Berlin, Conn. | 47,552 |
| Champion Bridge Co., Wilmington, O. | 46,900 |
| Wrought Iron Bridge Co., Canton, O. | 43,900 |
| Toledo Bridge Co., Toledo, O. | 44,688 |
| Philadelphia Bridge Co., Philadelphia, | 40,000 |
| Columbus Bridge Co., Columbus, O. | 40,700 |
| Penn Bridge Co., Beaver Falls, Pa. | 48,880 |
| R. F. Hawkins, Springfield, Mass. | 43,430 |

CUMBERLAND, MD.—The county commissioners are reported as having decided to pay half the cost of a bridge over the Potomac River at Luke, Md., if it can be built for $11,000. Mineral county, W. Va., will probably be asked to pay the other half.

WASHINGTON, D. C.—The House committee on commerce has favorably reported the bill appropriating $5,000 for surveys for a bridge across the Eastern Branch, at the foot of South Capitol St.

MURPHY, N. C.—W. M. West, Chn. County Comrs., writes us that the time for considering the bids for the proposed bridge has been postponed until Aug. 6.

BIRMINGHAM, ALA.—Press reports state that a long trestle on the Kansas City, Memphis & Birmingham R. R., near Adamsville, was burned by striking miners, July 1.

LOUISVILLE, KY.—The Louisville & Jeffersonville Bridge Co. has paid the first installment of $25,000 to the Phoenix Bridge Co. and the contract for the completion of the structure by Dec. 31, 1894, has been signed, according to statements in local papers.

NATCHEZ, MISS.—The following bids were received by the Supervisors of Adams county for the proposed steel bridge over St. Catherine Creek, according to press reports:

| | |
|---|---|
| W. H. Converse Bridge Co., Chattanooga, Tenn. | $10,000 |
| Youngstown Bridge Co., Youngstown, O. | 9,350 |
| A. M. Searles, Vicksburg, Miss. | 9,124 |
| Iron Sub-Structure Bridge Co., Columbus, O. | 9,880 |
| Massillon Bridge Co., Massillon, O. | 9,500 |
| Groton Bridge & Mfg. Co., Groton, N. Y. | 10,200 |
| Milwaukee Bridge & Iron Wks., Milwaukee, Wis. | 9,777 |
| George H. Crafts, Atlanta, Ga. | 9,810 |
| Brackett Bridge Co., Cincinnati, O. | 9,622 |
| *King Iron Bridge Co., Cleveland, O. | 8,800 |
| Penn Bridge Co., Beaver Falls, Pa. | 9,300 |
| Fox, Shaw & Co., Natchez, Miss. | 10,125 |
| Champion Bridge Co., Wilmington, O. | 11,000 |
| Columbus Bridge Co., Columbus, O. | 9,418 |

*Awarded contract.

NEW ORLEANS, LA.—The following bids were received for a new bridge at the halfway house: Youngstown Bridge Co., $12,350; J. L. O'Connor, $14,000; Toledo Bridge Co., $12,350; Milwaukee Bridge Co., $14,150; King Bridge Co., $14,000.

CINCINNATI, O.—The contract for the superstructure of the bridge across the Big Miami River at Venice has been awarded to the King Bridge Co., Cleveland, at $34,698, upon the recommendation of Frank Krug, County Engr., and Chas. F. Stowell, Consult. Engr., New York. The bids were as follows:

| | |
|---|---|
| Wrought Iron Bridge Co. | $33,375 |
| Toledo Bridge Co. | 17,490 |
| Variety Iron Wks. | 24,559 |
| Massillon Bridge Co. | $23,783 and 28,176 |
| Phoenix Bridge Co. | 17,560 |
| Youngstown Bridge Co. | 18,000 |
| Brackett Bridge Co. | 34,998 |
| Detroit Bridge Co. | 33,700 |
| King Bridge Co. (4 plans) | $26,500 to 34,950 |

CLEVELAND, O.—Bids are asked until Aug. 8 for reconstructing the superstructure and repairing the foundation for the fixed span of the Jefferson St bridge. Plans and specifications may be seen after July 22. J. H. Farley, Dir. Pub. Wks.

EAST LIVERPOOL, O.—The East Liverpool Bridge Co. has been organized to build the proposed bridge across the Ohio River at this place. The city council has granted the necessary franchise, with a railway clause annexed, and the plans for the bridge have been approved by the Secretary of War, at Washington. The estimated cost of the work is about $200,000.

TOLEDO, O.—The city clerk has been directed to advertise for bids for the construction of a bridge over Swan Creek on St. Clair St.

BLOOMINGDALE, MICH.—Bids are asked for materials and construction of bridge abutments and wings, according to reports. E. Cone, Highway Comr.

MARINETTE, WIS.—The councils of this city and Menominee have condemned the wooden bridge between the two cities.

OSCEOLA, WIS.—The House has passed a bill authorizing this village to construct a general traffic bridge across the St. Croix River.

RIVER JUNCTION, IA.—The supervisors of Washington and Johnson counties have ordered the construction of a new iron bridge across the Iowa River at this place.

SIOUX CITY, IA.—The Combination Bridge Co. has been incorporated with a capital stock of $2,000,000 to construct a wagon bridge across the Mississippi River. Wm. Reynolds, W. C. Silverthorne and Wm. Faxon, Jr., are incorporators. The city has voted a tax of $340,000 for this bridge, as noted last week.

HASTINGS, MINN.—Oscar Claussen, Engr., 113 Germania Life Insurance Bldg., St. Paul, writes us that the following bids were received July 2 for constructing the proposed highway bridge across the Mississippi River:

| | | |
|---|---|---|
| Wisconsin Bridge & Iron Co. | $31,560 to | $40,000 |
| Mount Vernon Bridge Co. | 39,800 to | 43,500 |
| King Bridge Co. | ..... | 36,500 |
| Missouri Valley Bridge & Iron Co. | 35,000 to | 39,281 |
| Chicago Bridge & Iron Co. | ..... | 35,994 |
| Milwaukee Bridge & Iron Co. | 36,058 to | 39,721 |
| New Jersey Steel & Iron Co. | ..... | 36,949 |
| Carl Binder | ..... | 39,800 |

RED WING, MINN.—Bids are asked until Aug. 3 for constructing a bridge across the Mississippi River at this place. The work will comprise two 94 ft. deck spans, one 430-ft. through span, one 220-ft. deck span and about 150-ft. of trestle work, all of steel, and was advertised in our issues of June 21 and 28. This is a postponement of date from July 13. Engr., Chas. F. Loweth, St. Paul. L. P. Wolff, Cy. Engr.

JEFFERSON CITY, MO.—The Jefferson City Bridge & Transit Co. has increased its capital stock from $2,000 to $200,000.

LEXINGTON, MO.—The Senate has authorized the construction of a bridge across the Mississippi River at this place.

ST. STEPHEN, N. B.—The contract for building the piers of the proposed bridge between this place and Calais, Me., has been awarded to Jas. McVay, St. Stephen, at $12,000, and that for the superstructure to the Boston Bridge Co., at $14,300.

## WATER-WORKS.

BOOTHBAY, ME.—The town has contracted for works, according to reports, the supply to be taken from Adams Pond, three miles from the village.

LEWISTON, ME.—The council has appropriated $8,000 toward increasing the pumping capacity of the works.

PITTSFIELD, ME.—The town has voted to purchase the franchise of the Pittsfield Water Co. and to put in works. J. F. Connor, O. Murray and U. L. Perkins, Committee.

LACONIA, N. H.—There is talk of purchasing the works.

LANCASTER, N. H.—The deed conveying the works to the fire district was signed June 30, price being $72,423.

NEW MARKET, N. H.—A contract was signed last week with J. F. Springfield, Rochester, and O. A. Gibbs,

Dover, who will put in works. They are guaranteed $2,000 per year hydrant rental and no taxes, according to reports.

SOMERSWORTH (P. O., Great Falls), N. H.—The council has authorized the employment of an engineer to investigate the question of supply.

LUDLOW, VT.—F. A. Walker writes us that W. W. Stickney, E. A. Howe and L. G. Hammond have been elected a committee to build works, for which $30,000 has been appropriated. Bonds cannot be issued until the charter is amended by the legislature.

MANCHESTER, VT.—Miller & Marsden have begun the construction of works for this village and Manchester Center. About ten miles of pipe will be required and two 1,000,000-gallon reservoirs.

BARRE, MASS.—The Barre Water Co., chartered May 12, has elected temporary officers.

BECKET, MASS.—The fire district has voted to issue $20,000 in 5% water bonds. M. A. Harwood, Dr. O. J. Shepardson and C. D. Smith, Comrs.

CAMBRIDGE, MASS.—Bids are asked until July 14 for 14½ tons of 24-in. cast iron flanged pipe and 16½ tons of special castings. L. M. Hastings, Cy. Engr.

LEOMINSTER, MASS.—It is stated that an experimental artesian well will be sunk for a supply.

MARLBORO, MASS.—The council has directed the committee on fire department to investigate the advisability of a stand-pipe in the western part of the city.

MEDFORD, MASS.—The mayor has asked for an appropriation of $25,000 for larger mains.

NEWBURYPORT, MASS.—The directors of the Newburyport Water Co. have voted to secure an additional supply.

READING, MASS.—It is stated that the Hydraulic Construction Co., New York, has offered to secure a daily supply of 1,000,000 gallons from driven wells, at a maximum expense of $10,000.

STONEHAM, MASS.—The citizens have voted, 130 to 2, in favor of the proposed purchase of the works for $667,000.

NORFOLK, CONN.—E. Worthington, Jr., & Co., Engrs., Boston, write us that the contract for works has been awarded to J. N. Riley, New York, at $41,890.

ALBANY, N. Y.—Bids are asked by the superintendent until July 17 for building the foundation for the pump and for extensions of the buildings on Montgomery and Water Sts.

BROOKLYN, N. Y.—The commissioner of city works has asked for $2,487,000 for an additional daily supply of 25,000,000 gallons, and it is expected that $700,000 will be appropriated next week for four new pumping stations of this capacity.

BUFFALO, N. Y.—Bids are asked until July 18 for excavating and removing rock in conduits and wells at lower pumping station and for setting the iron gate frames. R. G. Parsons, Acting Secy., Dept. Pub. Wks.

EARLVILLE, N. Y.—The contract for works has been awarded to Flood & Sherrill, Glens Falls, at $15,495. Chas. Millar & Son's pipe and Ludlow valves and hydrants to be used, according to reports.

RHINEBECK, N. Y.—Concerning the report published last week, J. C. McCalky, Clk., writes us that nothing has yet been done.

SMYRNA, N. Y.—There is talk of putting in works, according to reports.

WESTFIELD, N. Y.—Bids are asked until July 26 for 4 and 6-in. pipe, lead, pipelaying, etc. Geo. W. Patterson, Acting Supt.

MILLVILLE, N. J.—L. H. Hogan, Cy. Clk., writes us that the report on works was to have been presented to the council July 6, but that nothing definite has yet been done.

NEWTON, N. J.—The town has voted to put in works. Dr. Alexander Craig, A. J. Blarcom and Hiram C. Clark, Comrs.

ORANGE, N. J.—The committee has voted to recommend that the meter system be adopted.——The city engineer has reported that a stand-pipe at Berkeley Ave. would cost $7,500.

WESTWOOD, N. J.—C. S. De Baun has been granted a franchise for works; supply from an artesian well.

ALLENTOWN, PA.—Bids are asked until July 19 for enlarging the storage basin at pumping station; basin to have concrete floor, to be 9 ft. deep and surrounded by a wall 2 ft. thick; about 104 ft. of 10-in. pipe, with Chapman gate, will be laid. Cy. Engr., Robt. Rathbun. J. J. Snyder, Secy.

BRYN MAWR, PA.—A preliminary injunction has been granted restraining J. H. Daw and the American Pipe Mfg. Co. from laying water pipes on the Philadelphia, Bala & Bryn Mawr turnpike in this place and Bala.

EAST BANGOR, PA.—There is talk of building works, according to reports.

HATBORO, PA.—Comly Walton, Clk., writes us that the whole subject has been referred to a committee and a report is not expected for a month or two. Engr. Elmer S. Shelley, Hatboro.

LEBANON, PA.—A correspondent writes us as follows: The water board of councils has authorized extensive surveys to be made with a view to increasing supply. The present supply is two impounding reservoirs and one distributing reservoir, holding in all about 1,000,000 gallons and located 7 miles south of the city, from which for 22 years a daily supply of 745,000 gallons has been derived. Increasing population and iron industries make it necessary to increase the daily supply to 4,000,000 or 6,000,000 gallons, which will probably be brought from the mountains ten miles north of the city, the plant to be operated by water power, of which there is an abundance at the locality selected. The plant will cost several hundred thousand dollars. W. N. McCullough, Philadelphia, has been engaged to make the necessary surveys, plans and specifications and the construction will no doubt be commenced at an early date.

MACUNGIE, PA.—John Erdman, Secy. Council, writes us the council is securing a gravity supply. No engineer has been engaged or contract awarded. The pipe will probably be purchased this month and the work done by day labor; estimated cost, $8,000 to $12,000.

McDONALD, PA.—Bids are asked until July 18 for constructing works, as stated in our advertising columns. Engrs., Potter & Folwell, Pittsburg. E. S. McWreath, Secy.

DOWNINGTON, PA.—An election will be held July 16 to vote on an appropriation of $30,000 for works.

WILKES BARRE, PA.—It is stated that the Falling Springs Water Co., the incorporation of which was noted last week under Harding, Pa., is having surveys made for building cribs in the Susquehanna River above the mouth of the Lackawanna and laying mains down on the east side of the river to supply the water companies of this city and other places in the valley.

ANNAPOLIS, MD.—Bids are asked until July 19 for 1,160 ft. 14 and 16-in. pipe, pipelaying, and for a 2,000,000-gallon pumping engine, as stated in our advertising columns. Engrs., Jas. H. Harlow & Co., Pittsburg. J. H. Iglehart, Secy. Annapolis Water Co.

SALTVILLE, VA.—The completion of the distributing reservoir June 30 pratically completes the works of this town. The entire system has been built under the supervision of Emile Low, Engr., Saltville.

WHEELING, W. VA.—Local papers state that the residents of Altenheim are arranging with the Altenheim Water-Works Co. for a supply for fire protection; also that the citizens of Leatherwood are taking steps to secure a supply.

PARKERSBURG, W. VA.—W. E. Powell, Pres. Mountain Home Co., noted last week as incorporated, writes us that the company will build nothing but cottages this year; water-works and other improvements later.

WINSTON, N. C.—J. O. Magruder, Cy. Engr., writes us that Aug. 7 the citizens will vote on an appropriation of $100,000 for extending and improving the works.

JACKSONVILLE, FLA.—The city has sold $900,000 of 6% water-works and improvement bonds at par, the bonds having been declared valid.

MARION, ALA.—It is stated that the council will advertise for bids for constructing works. Mr. Waller, who had the contract, has bored to a depth of 550 ft. without finding water and has thrown up his contract, according to reports.

CROWLEY, LA.—O. H. Landreth has been engaged to make surveys and superintend the construction of works and an electric light plant.

SPRINGFIELD, TENN.——E. A. Hicks, Cy. Recdr., writes us that the question of works is being agitated, but that no appropriation has been made.

NICHOLASVILLE, KY.—The city has refused to pay the Nicholasville Water Co. for the supply furnished and won the suit on the ground that the supply was not pure water. The city supply has now been shut off, according to press reports.

BUCYRUS, O.—The city is considering the question of new works to be owned by the city and is reported as wishing estimates on a $100,000 plant. H. L. Weber, Cy. Engr.

CANAL DOVER, O.—Press reports state that the citizens have voted at a mass meeting to put in works.

DAYTON, O.—Bids are asked until July 16 for laying service pipes in three streets. C. A. Herbig, Cy. Comptroller.

CAMBRIDGE CITY, IND.—C. H. Tabke, Clk., writes us that the water question will be voted upon July 24.

HUNTINGTON, IND.—Bids are asked until July 14 for rearranging and lowering pumping machinery, etc. Sam'l Buchanan, Clk.

PORTLAND, IND.—The citizens have voted to issue $40,000 in bonds for works, and C. W. McLaughlin writes us that the bonds have been negotiated; work to be commenced as soon as money is received.

ALTON, ILL.—Plans have been made for a new crib, the old filter having become useless.

DE KALB, ILL.—It is reported that $18,000 has been appropriated for extensions.

LEXINGTON, ILL.—A. B. Davidson, Cy. Clk., writes us that an election will be held July 17 to vote on an appropriation of $7,500 for works; supply from wells; population, 1,500. No engineer has been engaged.

MORRIS, ILL.—The West Side Artesian Well Co. has been incorporated with a capital stock of $1,500.

QUINCY, ILL.—The water company has petitioned for an extension of its franchise from 1903 to 1925. If this is granted it is stated that $100,000 will be spent for new mains and other improvements.——M. E. McMaster is reported as interested in a new water company that is being organized.

ANTIGO, WIS.—The city is reported as talking of purchasing the works.

MILWAUKEE, WIS.—It is proposed to issue $100,000 of 5% bonds to extend the mains to the county buildings at Wauwatosa.

BRITT, IA.—The contract for works has been awarded to the U. S. Wind Engine & Pump Co., Batavia, Ill., at $6,150.

CEDAR RAPIDS, IA.—Bids will probably be opened about Aug. 1 for works estimated to cost $8,000. E. L. Sargent, Village Clk.

SHELDON, IA.—W. H. White & Co., Beloit, Wis., are to complete the works for $16,000, according to reports.

TRAER, IA.—W. J. Ladd, Cy. Recdr., writes us that bids are asked until July 12 for a deep well and that specifications will soon be completed for works, estimated to cost $7,500; population, 1,250.

ALBERT LEA, MINN.—The contract for proposed extensions has been awarded to Fairbanks, Morse & Co., St. Paul, at $5,837. Bids were also received from E. T. Sykes, Minneapolis, and Million & Young, St. Paul.

ELYSIAN, MINN.—A contract has been awarded for an 8-in. well and it is stated that bids for constructing works will be asked as soon as a water supply has been secured.

MARSHALL, MINN.—Bids are asked until July 30 for the purchase of $25,000 in bonds and until about the same date for constructing works and electric light plant, including a deep well; population, 1,800. Specifications furnished by E. T. Sykes, Minneapolis. C. F. Case, Village Pres.

MINNEAPOLIS, MINN.—The city engineer is investigating the filter plants in other cities.

NORTHFIELD, MINN.—Bids are asked until July 27 for constructing works, for which $40,000 in bonds have been voted. The work will include 30,600 ft. 12 to 4-in. pipe, 51 hydrants, 33 gates, pumping plant and a reservoir, as stated in our advertising columns. Engr., Chas. F. Loweth, St. Paul. M. W. Skinner, Chn. Com.

WELLS, MINN.—An election will be held July 24 to vote on an issue of $18,000 in bonds for works and electric lights.

HARVARD, NEB.—The citizens have voted to issue $7,500 in bonds for works.

CENTERVILLE, S. DAK.—The bids for constructing works ranged from $10,200 to $14,000, and it is stated that the contract for a stand-pipe and boiler was awarded at $3,358 and that the material will be purchased and the work done by day labor.

GLASGOW, MO.—Bids are asked until July 14 for constructing works. This is a postponment from July 7. H. Clay Cockerill, Secy.

KOHOKA, MO.—A committee has been appointed to investigate the question of works.

GOLIAD, TEX.—The Goliad Water Power Co. is reported as in the market for materials for works.

GOLDEN, COLO.—A press report states as follows: Messrs. Shafroth and Allen, of Denver, representing the South Platte Canal & Reservoir Co., or more properly the Citizens' Water Co., appeared before the board of commissioners July 2 and asked its approval of plans for the construction of a huge dam across the South Platte River. This dam will be located about 20 miles southwest from Platte Canon and will be partially in Jefferson and partially in Douglas counties. The dam will be 473 ft. in width and 211 ft. in height. It is designed to improve the supply of the Citizens' Water Co.

NEPHI, UTAH.—Two miles of pipe has been ordered for extensions, according to reports.

SALT LAKE CITY, UTAH.—The council is considering the question of a supply from Big Cottonwood River, at an estimated cost of $60,000.

NEW WHATCOM, WASH.—The council has been petitioned by prominent property owners to extend the intake into the lake at a cost of $7,000 to $9,000.

TACOMA, WASH.—Press reports state that it is now proposed to build a wooden flume to the Thomas-Patterson springs, costing $100,000, and expend the balance of $230,000 for extension purposes, to build to Lake Kapousin.

## IRRIGATION.

NEW COMPANIES.—Elm Creek Irrigation Co., Elm Creek, Neb.; $25,000; J. Boyd, F. McCall, Robert Mitchell, J. T. McJilton and John Richards.——Sutherland & Paxton Land & Irrigation Co., Sutherland, Neb.; $60,000; David Hunter, Alex. Neilson and J. H. Conway.——Mutual High Line Irrigation Co.; to operate in Mesa county, Colo.; $2,000,000; J. E. Price, T. E. Poole, F. L. Bellam and Chas. N. Cox.——Bow Creek Irrigation Co., Stockton, Kan.; $30,000; I. N. Pepper and E. R. Pepper, Stockton; W. W. Wick, Topeka, and L. C. Mudge, Burlington, Ia.——Richards Irrigation Co., Union, Utah; $12,000; C. B. Baker, De Norand Griffin, Rufus Forbash and others.——Banner Irrigation Co., Gothenburg, Neb.; $20,000; F. Hecot, H. S. Davis, H. L. Williams, W. N. Pierce, J. E. Stone and others

## SEWERS.

CARIBOU, ME.—P. L. Hardison is making surveys for a system.

GARDINER, ME.—Geo. H. Harrington has been elected superintendent of proposed sewers in Brunswick Ave. and Spring St.

ROCHESTER, N. H.—An ordinance has been adopted appropriating $32,000 for completing the system. Engr., Ernest W. Bowditch, Boston.

ATHOL, MASS.—Col. G. E. Waring, Jr., Newport, R. I., has been engaged to prepare plans for a system.

BELMONT, MASS.—W. L. Chenery, Town Clk., writes us that $18,000 will be appropriated by the town to build a main sewer, provided that $9,000 additional is contributed by the state hospital or others for the same purpose.

FAIRHAVEN, MASS.—The committee has recommended the construction of the Shone system of sewerage, estimated to cost $65,539. G. H. Palmer, Chn.

LOWELL, MASS.—The committee has voted to construct sewers in eight streets.

SOUTH FRAMINGHAM, MASS.—The commissioners have awarded the contract for pipe to H. L. Sawyer and that for building manholes to A. D. Swan. Work will be commenced about July 16.

WOONSOCKET, R. I.—Right of way is being secured for a combined system upon which it is reported that work will probably be commenced in the fall.

NEW HAVEN, CONN.—The board of public works has received the following bids for constructing three sewers:

| | Orchard St. | Dickerman St. | Evergreen Cemetery. |
|---|---|---|---|
| C. W. Blakeslee & Sons.. | *$1,554 | $1,468 | $2,715 |
| A. Brazos & Son..... | 1,575 | 1,460 | 2,925 |
| Patrick Maher & Son..... | 1,589 | 1,500 | *2,276 |
| Lawrence O'Brien..... | 1,613 | 1,518 | 2,622 |
| Patrick Dowling..... | 1,779 | 1,688 | .... |
| Anthony Carroll..... | 1,838 | *1,428 | .... |

* Awarded contract.

WILLIMANTIC, CONN.—H. D. Card has been engaged to superintend the construction of sewers, and the mayor has been directed to issue $50,000 of 4% bonds.

BROOKLYN, N. Y.—J. J. Moran & Co. have been awarded the contract for building the Greene Ave. relief sewer extension at $169,513. The itemized bids were published June 28.

BUFFALO, N. Y.—The council has adopted ordinances for constructing 15 to 10-in. pipe sewers in several streets, and 30 to 21-in. brick sewers in two streets.

CAZENOVIA, N. Y.—It is stated that the citizens will soon vote on the question of sewers.

DEPEW, N. Y.—J. C. Bowen is reported to have sold 21 acres to Eastern capitalists, who, it is stated, will put in sewers, water-works, and make other improvements.

GLOVERSVILLE, N. Y.—Bids are asked until July 16 for constructing about 2,210 ft. of 8 to 4-in. pipe sewers. E. B. Baker, Engr.

KINGSTON, N. Y.—E. B. Codwise, Cy. Engr., writes us that the committee has reported in favor of a main sewer in the Second and Ninth Wards, but that no other action has been taken.

MIDDLETOWN, N. Y.—The council is considering extending the outlet sewer 1½ miles, which the mayor states would cost $10,000 to $12,000.

TICONDEROGA, N. Y.—It is reported that W. W. Jeffers, Asst. State Engr., has been engaged to make surveys for a system.

BLOOMFIELD, N. J.—The contract for constructing sewers in three streets has been awarded to H. M. Dowd & Co., Orange, at $3,565.

NEWARK, N. J.—Bids are asked until July 19 for constructing 440 ft. of 24 × 36-in. brick and 430 ft. of 12-in. pipe sewers. J. G. Mundy, Gen. Supt. Wks.

PLAINFIELD, N. J.—Bids will soon be asked for building a portion of the proposed system. We are officially informed that the sewer ordinance will become a law about Aug. 4, and that contracts will then be awarded for constructing 5 to 7 miles of main sewers this fall, and that the remaining portion will be built next year. The soil is sand and gravel and free from rock or boulders. The surface is uniform; depth of trench, 5 to 15 ft.; average depth about 8 ft. The city has no bonded debt, and will pay cash for the construction. Specifications will be ready by Aug. 1. A separate system is proposed, with sewerage disposal by downward intermittent filtration. Consult. Engr., F. W. Farquhar, of Waring, Chapman & Farquhar, 874 Broadway, New York. For other information address J. W. McMurray, Cy. Clk.

WOODBURY, N. J.—The council has adopted plans for a separate system prepared by Waring, Chapman & Farquhar, Newport, R. I.

ALTOONA, PA.—The council is discussing a proposition to appropriate $150,000 for sewers.

ERIE, PA.—The council has passed an ordinance for constructing a brick main sewer in 24th St.

MINERSVILLE, PA.—Bids are asked until July 16 for constructing 1,173 ft. of 30 to 15-in. brick sewers. J. W. Forney, Chn. St. Com.

SEWICKLEY, PA.—A. Neille & Co., Allegheny, have been awarded contracts for building sewers in five streets.

WASHINGTON, D. C.—The House district committee has decided to report in favor of issuing $7,500,000 in bonds, of which $4,350,000 will be used for extending the sewer system and the remainder for street extensions.

CHARLOTTESVILLE, VA.—Bids are asked until July 26 for constructing a system of pipe sewers, as stated in our advertising columns. N. W. Davis, Engr.

KNOXVILLE, TENN.—Bonds for $35,150 have been sold, which will be used for constructing sewers in West Knoxville, plans for which have been adopted.

NEWPORT, KY.—Contracts for sewer construction aggregating about $15,000 have been awarded to Wm. White, Newport.

CINCINNATI, O.—Bids are asked by the board of administration until July 27 and 31 for constructing sewers, one sewer at each date.

CLEVELAND, O.—The board of control has prepared plans for constructing sewers in ten streets. J. H. Farley, Dir. Pub. Wks.

HAMILTON, O.—The council has received bids from the following bidders for constructing sewers in four districts: E. A. Hicks, Hamilton; B. D. Bartow, Port Huron, Mich.; Duemer & White, Hamilton; Hutchinson & Manear, Hamilton; McHenry & Davis, Anderson, Ind.; Westwater & Babbitt, McCarthy & Sagers, Cleveland; F. R. Vinnedge, Hamilton; R. N. Andrews, Hamilton; Martin Burger & Co., Cincinnati; Berry & Meehan, Middletown, O.; Henry Louthan, Hamilton; Ulrich, Nissley & Williams, Springfield; The Toledo Construction Co., Toledo; C. L. Crowley, Hamilton; W. R. Mercer, Indianapolis; Greenville Construction Co., Greenville, O.; John Munger & Co., Dayton; Meir & O'Sullivan, Strack, Wilson & Kinch, Cincinnati and Hamilton; C. W. Danerhower, Cincinnati; W. W. Cook, Sistersville, W. Va.; Azel B. Smith, Springfield.

SOUTH BEND, IND.—Bids are asked until July 23 for the construction of six sewers. L. A. Hull, Cy. Clk.

DETROIT, MICH.—The council has received the following bids for constructing a brick sewer in Owen Park:

| | |
|---|---|
| M. Blay & Son | $45,514 |
| John Wagner | 43,319 |
| W. H. Collins | 42,006 |
| Liphardt & Winterhalter | 44,244 |
| Langley & Jeynes | 42,267 |
| Wm. P. Langley (awarded contract) | 42,234 |

BELLEVILLE, ILL.—The contract for constructing sewers in Main St. has been awarded to the Abbot-Gamble Contracting Co., St. Louis, Mo., at $4,700.

LE MARS, IA.—It is reported that bids are now being asked for constructing 20,814 ft. of 22 to 8-in. pipe sewers.

ST. CLOUD, MINN.—It is proposed to build a main sewer to cost about $75,000.

BUTTE, MONT.—The council is discussing the construction of sewers in six streets.

ST. JOSEPH, MO.—W. E. Gibson has been awarded the contract for constructing 2,300 ft. of brick sewer in Mitchell Ave., at $12.17 per ft.

ST. LOUIS, MO.—The board of public improvements has adopted ordinances for extending sewers in four streets; estimated cost, $71,000.

WACO, TEX.—The council has authorized the mayor to advertise for bids for constructing sewers in East Waco.

DENVER, COLO.—The board of public works has voted to advertise for bids for constructing a sewer in Capitol Hill.

## STREETS.

CENTREDALE, R. I.—The citizens of North Providence have voted to appropriate $15,000 for street improvements.

CENTRAL FALLS, R. I.—Bids are asked until July 21 for furnishing about 6,500 sq. yds. of granite paving blocks, as stated in our advertising columns. R. S. Dame, Highway Surv.

CRANSTON, R. I.—It is proposed to improve two streets. D. D. Waterman, Village Clk.

PAWTUCKET, R. I.—The council is discussing widening and improving two streets.

BROOKLYN, N. Y.—Bids are asked until July 17 for grading and paving two streets with cobblestones. A. T. White, Comr. Cy. Wks.

BUFFALO, N. Y.—The council has ordered the following paving; Rodney St., estimated to cost $28,916; Victoria Ave., $20,695; and Wakefield Ave., $19,853.

LOCKPORT, N. Y.—The lowest bid received by the council for paving Buffalo St. was that of C. N. Stainthorpe & Co., Lockport, for United States fire clay brick, $7,165, and Park fire clay brick at $6,965; the other bidders being J. W. Ward, J. C. Sheldon, M. J. Crowe, all of Lockport, and L. H. Gipps, Tonawanda.

SYRACUSE, N. Y.—The following bids have been received for paving Montgomery St.: Warren-Scharf Asphalt Paving Co., $12,880; Trinidad Asphalt Refining Co., New York, $12,971; and the Syracuse Improvement Co., $13,036.

UTICA, N. Y.—The council has decided to pave Park Ave. with Trinidad Lake asphalt.

NEWARK, N. J.—Bids are asked until July 19 for 1,400 sq. yds. of asphalt paving in Camp St. J. O. Mundy, Gen. Supt. Wks.

COLLINDALE, PA.—R. T. Pharo, Borough Clk., writes us that some public improvements are contemplated this fall.

DARBY, PA.—The city has offered to contribute $5,000 toward paving Main St. with brick.

ERIE, PA.—Bids are asked until July 19 for paving with asphalt. George Platt, Cy. Engr.

JOHNSTOWN, PA.—The council is discussing an ordinance for borrowing $50,000 for paving seven streets with brick.

PITTSTON, PA.—The citizens have voted $38,000 for repaving streets and constructing sewers.

DAVIS, W. VA.—It is reported that an election will be held to vote on issuing bonds for street improvements.

ST. AUGUSTINE, FLA.—The council is discussing proposed street paving.

BOWLING GREEN, KY.—Contracts have been awarded to Dennis Milane and McLellan Stone Co., at $3.35 to $3.99 per 100 sq. ft.

AVONDALE, O.—Bids are asked until July 31 for improving Wilson Ave. W. E. Wynne, Corporation Clk.

CINCINNATI, O.—The Ohio Bermudez Asphalt Paving Co. has been organized; Pres., Frank Kirchner, Cincinnati; Secy., William McConville, Pittsburg, Pa.

COLUMBUS, O.—The council has adopted a resolution to pave Parsons Ave.; estimated to cost, with brick, $70,090, or with asphalt, $100,450.

DAYTON, O.—Bids are asked until July 30 for 29,700 sq. yds. of paving with Medina stone, asphalt blocks, brick, or sheet asphalt; 10 contracts. C. A. Herbig, Cy. Comptroller.

MANSFIELD, O.—Bids are asked until Aug. 4 for improving two streets. F. M. Remy, Cy. Clk.

SALEM, O.—Bids are asked until July 17 for constructing stone sidewalks. F. W. Allison, Cy. Clk.

INDIANAPOLIS, IND.—The board of public works has received the following bids for brick paving: Fulmer & Seibert, $4.50 to $4.79 per lin. ft.; Capitol Paving & Construction Co., $4.97 to $5.15; Wilding & Derheimer, $5.07 to $5.39; Acme Paving Brick Co., $5.48 to $5.79; Dan'l Foley, $6.60 to $6.75; Indiana Paving Brick Co, $5.15 to $5.62; Western Paving Co., $5.62.

GRAND RAPIDS, MICH.—Miller & Hoffert have been awarded the contract for improving Cherry St. and Lake Ave., at $10,400.——Plans have been prepared for paving one street with brick at an estimated cost of $15,000.

LANSING, MICH.—Bids are asked for paving Capitol Ave. with brick. The bids received last week for this work were rejected by the board of public works.

JANESVILLE, WIS.—It is stated that the council will be petitioned to pave three streets.

MUSCATINE, IA.—Bids are asked until July 26 for about 50,000 sq. yds. of paving with one course of brick upon macadam. D. T. Eaton, Cy. Clk.

ST. LOUIS, MO.—Bids are asked by the board of public improvements until July 17 for constructing sidewalks in two districts with artificial stone flagging.—August & J. C. Heman were the lowest bidders for constructing sidewalks with artificial stone in two districts at $42,500, but former work by this company is reported as having been unsatisfactory and the board has readvertised the work.

GALVESTON, TEX.—The board of public works has directed the city clerk to advertise for bids for paving 42 blocks, estimated to cost about $100,000.

DENVER, COLO.—The chamber of commerce has recommended to the board of public works the paving of about 30 miles of streets.

## ELECTRIC LIGHT AND POWER.

DANBURY, CONN.—The council has appointed a committee to investigate the question of a municipal electric light plant.

BALTIMORE, MD.—The buildings of the Viaduct Mfg. Co., at Relay station, nine miles from the city, manufacturing electrical supplies, was totally destroyed by fire June 30; loss, $75,000. The plant will probably be rebuilt at once.

WESTMINSTER, MD.—It is reported that a company has been organized to put in an electric light plant for public and private lighting.

WASHINGTON, D. C.—It is reported that a syndicate has purchased 146 acres of land at High Island, and it is understood that an electric light and power plant will be erected at an estimated cost of about $750,000. This company is said to own two miles of river front. Horace S. Cummings is interested.

CROWLEY, LA.—O. H. Landreth has been engaged to make plans for an electric light plant. It is stated that the contract for the construction will be let as soon as the plans are completed.

ROANOKE, ILL.—The Roanoke & Benson Electric Light Co. is being organized.

LAFAYETTE, COLO.—J. S. Spencer has been granted an exclusive franchise for 40 years for an electric heat, light and power plant, according to reports.

NEW COMPANIES.—United Electric Corporation, Minneapolis, Minn.; $10,000; to construct electric light, heat and power plants; Samuel Grant, Faribault; G. R. Kibbe, P. W. Bossart, J. H. Finney, St. Paul.——Freeport Electric Co., Freeport, Ill.; $150,000; R. S. Brown, J. B. Taylor, G. H. Currie.——Economic Light, Heat & Power Co., Snohomish, Wash.; $25,000; H. W. Williams, A. W. Philips, J. T. Condon.——Nash-Eddy Co., Cleveland, O.; $12,000; to manufacture mechanical and electrical apparatus; Geo. A. Eddy, F. G. Botsford, H. W. Wolcott, L. H. Winch.

## MISCELLANEOUS CONTRACTS AND SUPPLIES.

DREDGING STEAMER.—Wilmington, N. C.—Bids are asked until Aug. 2 for building a dredging steamer. Maj. W. S. Stanton, U. S. Engr.

EXCAVATION, ETC.—Buffalo, N. Y.—The council is considering the construction of two cut-offs for the relief of South Buffalo from floods; estimated cost, $63,910.

JAIL.—Mammoth Hot Springs, Wyo.—Bids are asked until July 17 for the erection of a jail building in the Yellowstone National Park. Capt. Geo. S. Anderson, U. S. A.

ROCK REMOVAL.—Newport, R. I.—Bids are asked until July 31 for removing rock in Pawtucket River, as stated in our advertising columns. Capt. W. H. Bixby, U. S. Engr.

PUBLIC WORK.—Albany, N. Y.—Bids are asked until July 19 for 19 contracts for public work, including rebuilding locks, building walls, dredging, etc. Edward Hannan, Supt. Pub. Wks.

GAS WORKS.—Snohomish, Wash.—Press reports state that a franchise has been granted to Mr. Williams, an English capitalist, who will construct at once a system of gas works to cost $50,000.

BONDS.—Rochester, N. Y.—Bids are asked until July 17 for the purchase of $200,000 of 3½% county bonds, issued for the construction of a new court house. A. McVean, Treas. Monroe county.

ARMORY.—Cleveland, O.—The contract for constructing the new central armory on Lake, Bond, and Hamilton streets, has been awarded to John Gill & Sons, at $97,555. The bids were published last week.

IRON WORK.—Boston, Mass.—Bids are asked by the state house extension commissioners until July 16 for the bronze and wrought iron railings for the state house extension. Arch., Chas. Brigham, Beacon Hill Place.

DREDGING, ETC.—Block Island, R. I.—Bids are asked until July 24 for 330,000 cu. yds. of dredging. 750 ft. of pile sheathing and 6,400 tons of stone, as stated in our advertising columns. Edward P. Champlin, Town Clk.

PLUMBING, ETC.—Washington, D. C.—Bids are asked until July 31 for the plumbing, gas piping and electric wire conduits for the U. S. building at Newark, N. J., as stated in our advertising columns. Jeremiah O'Rourke, Supervising Arch., Treasury Dept.

BUILDING PLANS.—Atlanta, Ga.—Architects are asked to submit plans until Aug. 15 for the construction of six buildings for the United States International Exposition Co. The buildings for which plans are now asked are as follows: Manufactures, 300 × 430 ft.; machinery, 140 × 500 ft.; agriculture, 180 × 330 ft.; minerals and forestry, 110 × 350 ft.; electricity, 90 × 270 ft.; administration, 50 × 150 ft. Grant Wilkins, Chn. Bldg. Com., 9½ Peachtree St.

## CONTRACT PRICES.

STAND-PIPE.—Wheaton, Ill.—The contract for a 14 × 120-ft. steel stand-pipe for the new water-works is reported as awarded to the Brownell Co., Dayton, O., at $3,400.

BOILERS.—Troy, N. Y.—Geo. B. Fales, Clk. Comrs., writes us that the contract for two horizontal return tubular boilers of 175 HP. each for the water-works has been awarded to Pinkerton & Mull, Green Island, at $4,800 less $250 allowed for three old boilers to be taken out. The Franklin Iron Wks., Green Island, bid $4,950, as stated last week.

SEWER.—Covington, Ky.—Thos. H. Kennedy, Cy. Engr., writes us that the lowest accepted bid for the Willow Run sewer was that of Peter & Jonte, Cincinnati. There were 26 bids received and that of M. Garrettson & Co., Cincinnati, was $1,500 lower than the accepted bid, but was thrown out as informal. Peter & Jonte's bid was as follows:

Section 1.

| | | | | |
|---|---|---|---|---|
| 12-ft. brick, 4 rings, | 150 | ft., per lin. ft. | | $14.20 |
| 11-ft. " " | 1,450 | " " | | 13.15 |
| 5-ft. " 2 rings, | 50 | " " | | 3.75 |
| 3-ft. " " | 150 | " " | | 2.92 |
| 21-in. pipe, | 200 | " " | | 0.85 |
| 18-in. " | 140 | " " | | 0.61 |
| 6-in. slants, | 25 | each | | 0.22 |
| Manholes, | 7 | " | | 30.00 |
| Excavation, | 6,900 | cu. yds., per cu. yd. | | 0.30 |
| Extra filling, | 3,280 | " " | | 0.20 |
| Rubble masonry, | 2,000 | " " | | 3.20 |
| Concrete, | 800 | " " | | 3.20 |
| Timber foundation, | 16,800 | ft. B. M., per M. ft. | | 14.00 |
| Paving, 35 sq. yds., per sq. yd. | | | | 2.00 |
| Total for first section | | | | $33,430.60 |

Section 2.

| | | | | |
|---|---|---|---|---|
| 10-ft. brick, 3 rings, | 1,800 | ft., per lin. ft. | | $9.00 |
| 9-ft. " " | 425 | " " | | 8.10 |
| 6-ft. " " | 210 | " " | | 5.57 |
| 3-ft. " | 150 | " " | | 1.95 |
| 21-in. pipe, | 200 | " " | | 0.85 |
| 18-in. " | 200 | " " | | 0.61 |
| 6-in. slants, | 40 | each | | 0.22 |
| Manholes, | 20 | " | | 30.00 |
| Excavation, | 9,800 | cu. yds., per cu. yd. | | 0.20 |
| Extra filling, | 1,600 | " " | | 0.20 |
| Rubble masonry, | 1,800 | " " | | 3.20 |
| Concrete, | 800 | " " | | 3.20 |
| Timber foundation, | 16,000 | ft. B. M., per M. ft. | | 14.00 |
| Total for second section | | | | $32,499.50 |

CRUSHED GRANITE.—Portage, Wis.—A contract for 2,500 cu. yds., or more, of granite chips for street improvements has been awarded to A. J. Emerton, at $1.55 per cu. yd., according to press reports. The granite will be obtained at the quarry in Moundville.

BRICK AND ASPHALT PAVING.—Williamsport, Pa.—S. N. Williams, Chn. Com., writes us that contracts for paving with brick upon 6 ins. of concrete have been

awarded as follows: Jas. McCloud & Co., Zanesville, O., 7,100 sq. yds. with Canton blocks, at $2.04; D. P. Guise, Williamsport, 1,740 sq. yds. with brick of his own manufacture, at $1.80. The Sicilian Asphalt Paving Co., New York, bid $2.45 per sq. yd. for a 2½-in. surface of asphalt and $2.35 for a 2-in. surface, with a one-year guarantee, or $2.85 and $2.65 for a ten-year guarantee.

BRICK PAVING.—Lima, O.—R.H. Gamble,Cy.Engr., has sent us a synopsis of the bids received for paving Public Square with brick, and states that the committee will recommend Massillon brick with concrete foundation and Murphy filling: The city received proposals from 12 contractors, each bidding on from 2 to 12 different kinds of brick or block, on either 8 ins. of broken stone or 6 ins. of concrete foundation; also for tar, cement, Murphy's grout, or sand filling; thus giving a range of some 700 different proposals from which to select. The bidders were: Henry Marigold, Lima, O.; Horne & Hallwood, Columbus, O.; Wilding & Derheimer, Indianapolis, Ind.; Herring & Straub, Mansfield, O.; T. B. Empie, Fort Wayne, Ind.; Daum & Beeble, Mansfield, O.; W. H. Mandeville, Olean, N. Y.; H. W. Tapp, Fort Wayne, Ind.; V. H. Coons & Son, Findlay, O.; Barnett & Dodge, Akron, O.; D. K. McArthur, Kenton, O. The different kinds of brick bid upon were as follows: Massillon brick, Massillon, O.; blue granite block, Malvern, O.; standard shale and fire clay brick, Malvern, O.; Barnhard brick, Bellevaire, O.; Hayden block, Haydensville, O.; Hocking block, Logan, O. (made by the Hayden people); Hallwood block, Columbus, O.; Toronto brick, Toronto, O.; Canton shale, repress standard, end cut and royal block, Canton, O.; Mack shale and fire clay brick and block, New Cumberland, W. Va.; pyro-granite block, Logan, O.; Salem-Garfield brick, Garfield, O. The lowest bid on 8-in. stone foundation was by Wilding & Derheimer, on Malvern brick: Tar filling $1.25 per sq. yd.; cement filling, $1.22; Murphy filling, $1.22; sand filling, $1.17. The highest was: Tar filling, $1.85 on Hallwood block; cement filling, $1.84 on Massillon brick; Murphy filling, $1.90 on Massillon brick; sand filling, $1.69 on Massillon brick. The lowest bid on any kind of brick with concrete foundation was by V. H. Coons & Son: Tar or cement filling, $1.45 per sq. yd. on the Canton, Mack, or Malvern brick; sand filling, $1.35. The highest was: $2.06 on Massillon brick with tar filling; $2.09 on same with cement filling, and $1.96 on same with sand filling. The following shows the lowest and highest bids per square yard on the different kinds of brick or block, with concrete foundation and Murphy filling; V. H. Coons & Son being the lowest bidders on each kind except for the Toronto brick, upon which T. B. Empie bid $1.57:

| | Lowest. | Highest. | |
|---|---|---|---|
| Hayden block | $1.79 | $1.94 | H. & S. |
| Hocking block | 1.75 | 1.88 | " |
| Massillon brick | 1.59 | 2.15 | R. & B. |
| Mack brick | 1.51 | 1.96 | W. H. M. |
| Mack block | 1.51 | 1.96 | " |
| Canton brick | 1.51 | 1.96 | " |
| Canton block | 1.59 | 1.96 | " |
| Pyro-granite block | 1.59 | 1.63 | H.M'g'ld. |
| Malvern brick | 1.51 | 1.74½ | H. & S. |
| Toronto brick | 1.57 | 1.74½ | " |

Horne & Hallwood's bid on the Hallwood block was: Stone foundation—tar filling, $1.85; cement, $1.80; Murphy, $1.85; sand, $1.69; concrete foundation,—tar, $2; cement, $1.95; Murphy, $2; sand, $1.89.

Erie, Pa.—The contract for paving State St., from 12th to 14th Sts., with metropolitan brick upon 6 ins. of concrete has been awarded to V. D. Eichenlaub, at $1.35 per sq. yd.

Moline Ill.—Edwards & Walsh Construction Co. has been awarded the contract for paving 13th, 14th, 15th, 16th and 17th Sts. with Galesburg brick, at $1.23 to $1.32 per sq. yd. for paving; 91 × 12-in. catch basins, $21 each; 29 × 12-in., $14; 13 × 12-in., $9.50; 24-in. pipe sewer, $1.10 per lin. ft.; 18-in., 70 cts.; 15-in., 54 cts.; 12-in., 38 cts.; 4-in. drain tile, 8 cts.; new Berea sandstone curbstone, 61 cts. per lin. ft.; resetting old curbing, 8 cts.

Gloversville, N. Y.—The following bids were received last week for 21,900 sq. yds. of brick paving; bids received a few weeks ago for this work were published June 28:

| Bidder. | Paving, per sq. yd. With guarantee. | Paving, per sq. yd. Without guarantee. | Extra concrete, per sq. yd. | Setting curb, per lin. ft. |
|---|---|---|---|---|
| S. C. Ferguson, Gloversville | $2.37 | $2.27 | $5.00 | $.35 |
| Orr Bros., Alleghany City, Pa. | .... | 1.97 | 3.50 | .29 |
| *Park Paving Co., Rochester, Pa. | 2.10 | 2.10 | 3.50 | .20 |
| Seymour & Banker, Gloversville | 2.19 | 2.13 | 5.20 | .25 |
| C. A. & J Smith, Gloversville | 2.22 | 2.14 | 4.90 | .20 |
| Peter Callahan, South Bethlehem, N. Y. | 2.29 | 2.19 | 5.00 | .28 |

*Awarded contract.

Detroit, Mich.—The contract for paving Russel St., from Adelaide to Wilkins streets, with brick upon concrete, has been awarded to Liphardt & Winterhalter, at $1.85 per sq. yd., according to reports. Medina curbstone to be used. The total bids were as follows:

| | |
|---|---|
| William Lappin | $7,231 |
| Wm. Lappin, Hallwood blocks | 7,425 |
| Liphardt & Winterhalter, Imperial brick | 7,195 |
| Talbot Paving Co., Hallwood blocks | 8,117 |
| Laidlaw Bros., Trimble brick | 7,381 |
| Henry Merdian, Trimble brick | 7,548 |
| Patrick Dee, Hallwood blocks | 7,634 |

Oak Harbor, O.—E. A. Smith, Cy. Engr., writes us that the contract for 6,500 sq. yds. of brick paving, recently noted, has been awarded to Jacobs & Stewart at $8,468 for Salem-Garfield shale brick. The foundation will be of crushed stone 6 ins. deep and the cost, including grading and curbing, will be about $1.30 per sq. yd. The total bids were as follows:

| | |
|---|---|
| R. Richardson, Port Clinton, O. | $8,484 to $10,049 |
| Standard Const'n Co., Columbus, Parto block | 8,718 |
| C. J. Deckman, Malvern, O. | $8,425 and 9,408 |
| Herring & Straub, Mansfield, O. | 8,553 to 9,074 |
| Jacobs & Stewart, Norwalk, O. | 8,468 to 9,251 |
| P. L. & J. E. Maloney, Bellaire, O. | 10,331 to 10,918 |
| Lalley & Phillips, Bryant, Ind. | 9,116 to 9,834 |
| Snowflake Lime Co., Bowling Green, O. | 9,207 to 9,729 |
| Fabing & Fergerson, Fremont, O. | 10,297 to 11,210 |

Poughkeepsie, N. Y.—The contract for brick paving in Main St. has been awarded, according to press reports, to Orr Bros., Allegheny, Pa., at $2 per sq. yd., the other bidders being: Shale Brick Co., $2.11; Park Fire Clay Co., Pittsburg, $2.24; Interstate Brick Co., Keystone, Pa., $2.38.

WOOD PAVING.—Detroit, Mich.—A contract for paving in Wayne St. with sapless cedar blocks on concrete, with Medina curbstone, is reported to have been awarded to Geo. E. Currie, at $1.80 per sq. yd., the total bids being as follows:

| | |
|---|---|
| Wm. Lappin | $9,427 |
| E. H. Gilman | 9,417 |
| Laidlaw Bros. | 10,233 |
| Talbot Paving Co. | 9,906 |
| Liphardt & Winterhalter | 9,255 |
| George E. Currie | 9,142 |
| Patrick Dee | 9,578 |

ASPHALT BLOCK PAVING.—York, Pa.—J. G. Durbin, Cy. Engr., writes us that the contract for the proposed paving has been awarded to J. U. Fritchey, Lancaster, Pa., at $2.87 per sq. yd. for asphalt blocks, using the old macadam taken from street in making concrete for foundations. Bids were also received for paving the streets with brick, the other bidders being: Homer & Co., Olean, N. Y.; Odenwalt & Huber, York; R. A. Malone, Lancaster; Sawders & Houston, Pittsburg.

BELGIAN BLOCKS.—Baltimore, Md.—The following bids were received last week for furnishing 280,000 Belgian blocks, the price being given per 1,000 blocks: McCenahan Bros., 100,000 at $54.50; Westham Granite Co., 130,000 at $51.89, 150,000 at $59.75; Woodstock Granite Co., 200,000 at $60; M. Gault & Son, 150,000 at $52, 130,000 at $59.70; Rennie & McIntosh, 100,000 at $50.13, 180,000 at $53.53; I. S. Filbert, 50,000 at $55.50; Winsboro Granite Co., 280,000 at $61.50; Star Granite Co., 50,000 at $60, 50,000 at $63, 50,000 at $65, 50,000 at $67; Venable Bros., 280,000 at $57.24; Frank Peach, 50,000 at $54.90, 50,000 at $58.

## CONDENSED LIST OF CONTRACTS PENDING WITH DATE OF OPENING BIDS.

| Bids to be opened. | Work. | Place. | See Eng. News. |
|---|---|---|---|
| July 14. | Paving, | Akron, O. | June 21 |
| July 14. | Street improvements, | Avondale, O. | June 21 |
| July 14. | Stand-pipe, | Zanesville, O. | June 21 |
| July 14. | Water-wks syst'm, | Northumberland, Pa. | June 28 |
| | Advertised, Eng. News, June 28. | | |
| July 14. | Pipe and castings, | Cambridge, Mass. | July 12 |
| July 14. | Gravel road, | Marion, Ind. | July 12 |
| July 14. | Reset'g p'mp'g mach'y, | Huntington,Ind. | July 12 |
| July 14. | Water-works system, | Glasgow, Mo. | July 12 |
| July 16. | Paving (50,435 sq. yds.), | Dayton, O. | June 21 |
| July 16. | Electric light plant, | Millersville, Pa. | June 28 |
| July 16. | Water-works system, | Grafton, W. Va. | June 28 |
| | Advertised, Eng. News, June 28 to July 12. | | |
| July 16. | Water-works system, | Minot, N. Dak. | July 5 |
| July 16. | Macadamizing highway, | Trenton, N. J. | July 5 |
| July 16. | Iron railings, | Boston, Mass. | July 12 |
| July 16. | Pipe sewers, | Gloversville, N. Y. | July 12 |
| July 16. | Brick sewers, | Minersville, Pa. | July 12 |
| July 16. | Laying water service pipes, | Dayton, O. | July 12 |
| July 17. | Stone work, | Newport, R. I. | June 7 |
| | Advertised, Eng. News, June 7 to 28. | | |
| July 17. | Street improvements, | Bucyrus, O. | June 21 |
| July 17. | Water-wks. franchise, | Kaukauna, Wis. | June 28 |
| | Advertised, Eng. News, June 28 to July 12. | | |
| July 17. | Granite paving, | New York, N. Y. | July 5 |
| July 17. | Stone and sand, | New York, N. Y. | July 5 |
| July 17. | Dredging, | New York, N. Y. | July 5 |
| July 17. | Sewers, | New York, N. Y. | July 5 |
| July 17. | Pump foundation, etc., | Albany, N. Y. | July 12 |
| July 17. | Paving, | Brooklyn, N. Y. | July 12 |
| July 17. | Bonds, | Rochester, N. Y. | July 12 |
| July 17. | Sidewalks, | Salem, O. | July 12 |
| July 17. | Jail, | Mammoth Hot Springs, Wyo. | July 12 |
| July 17. | Artificial stone sidewalks, | St. Louis, Mo. | July 12 |
| July 18. | Sewers (17,070 ft.), | Dayton, O. | June 21 |
| July 18. | Paving, | Cleveland, O. | June 21 |
| July 18. | Stand-pipe foundation, | Glendale, O. | July 5 |
| July 18. | Stand-pipe, | Glendale, O. | July 5 |
| | Advertised, Eng. News, July 5. | | |
| July 18. | Pipe sewer (11,000 ft.), | Urbana, Ill. | July 5 |
| July 18. | Excavation, etc., | Buffalo, N. Y. | July 12 |
| July 18. | Water-works system, | McDonald, Pa. | July 12 |
| | Advertised, Eng. News, July 12. | | |
| July 19. | Floor arches, etc., | Worcester, Mass. | June 28 |
| | Advertised, Eng. News, June 28 and July 5. | | |
| July 19. | Bridge, | Albany, N. Y. | July 12 |
| July 19. | Asphalt paving, | Newark, N. J. | July 12 |
| July 19. | Public work (19 contracts), | Albany, N. Y. | July 12 |
| July 19. | Sewers, | Newark, N. J. | July 12 |
| July 19. | Enlarging water basin, | Allentown, Pa. | July 12 |
| July 19. | Asphalt paving, | Erie, Pa. | July 12 |
| July 19. | Pumping engine, etc., | Annapolis, Md. | July 12 |
| | Advertised, Eng. News, July 12. | | |
| July 20. | Water-works system, | Coxsackie, N. Y. | July 5 |
| | Advertised, Eng. News, July 5, 12. | | |
| July 21. | Paving bonds ($200,000), | Cincinnati, O. | June 28 |
| July 21. | Brick paving, | Cincinnati, O. | June 28 |
| July 21. | Water-works bonds, | Napoleon, O. | July 5 |
| July 21. | Granite blocks, | Central Falls, R. I. | July 12 |
| | Advertised, Eng. News, July 12. | | |
| July 21. | Road improvements, | Cincinnati, O. | July 12 |
| July 23. | Paving, | Montgomery, Ala. | July 5 |
| July 23. | Sewers, | South Bend, Ind. | July 12 |
| July 24. | Water-works, | Napoleon, O. | June 28 |
| | Advertised, Eng. News, June 28 and July 5. | | |
| July 24. | Electric light plant, | Napoleon, O. | June 28 |
| | Advertised, Eng. News, June 28 and July 5. | | |
| July 24. | Dredging, etc., | Block Island, R. I. | July 12 |
| | Advertised, Eng. News, July 12 and 19. | | |
| July 25. | Ironwork, etc., | Washington, D. C. | July 5 |
| | Advertised, Eng. News, July 5 and 12. | | |
| July 26. | Water-works system, | New Haven, Ind. | July 5 |
| July 26. | Cast iron pipe, etc., | Westfield, N. Y. | July 12 |
| July 26. | Pipe Sewers, | Charlottesville, Va. | July 12 |
| | Advertised, Eng. News, July 12 and 19. | | |
| July 26. | Brick paving, | Muscatine, Ia. | July 12 |
| July 27. | Sewer, | Cincinnati, O. | July 12 |
| July 27. | Water-works system, | Northfield, Minn. | July 12 |
| | Advertised, Eng. News, July 12. | | |
| July 28. | Power-house and bldg., | Detroit, Mich. | June 28 |
| | Advertised, Eng. News, June 28 to July 12. | | |
| July 30. | Street improvement bonds, | Ashland, O. | July 5 |
| July 30. | Street improvement bonds, | Norwood, O. | July 5 |
| July 30. | Highway, | Toledo, O. | July 5 |
| July 30. | Asphalt pav'g (29,700 sq.yds.), | Dayton, O. | July 12 |
| July 30. | Water-works bonds, | Marshall, Minn. | July 12 |
| July 31. | Bridge, | New Westminster, B. C. | June 21 |
| July 31. | Rock removal, | Newport, R. I. | July 12 |
| | Advertised, Eng. News, July 5 to 26. | | |
| July 31. | Plumbing, etc., | Washington, D. C. | July 12 |
| | Advertised, Eng. News, July 12 and 19. | | |
| July 31. | Street improvements, | Avondale, O. | July 12 |
| July 31. | Sewer, | Cincinnati, O. | July 12 |
| July 31. | Well, | Marshall, Minn. | July 12 |
| Aug. 1. | Sewer bonds ($100,000), | Victoria, B. C. | June 28 |
| Aug. 1. | Water-works system, | Carey, O. | July 5 |
| | Advertised, Eng. News, July 5 and 12. | | |
| Aug. 2. | Dredging steamer, | Wilmington, N. C. | July 12 |
| Aug. 3. | Bridge, | Red Wing, Minn. | July 12 |
| | Advertised, Eng. News, June 21 and 28. | | |
| Aug. 4. | Street improvements, | Mansfield, O. | July 12 |
| Aug. 6. | Electric lighting, | Rome, N. Y. | June 14 |
| Aug. 8. | Bridge, | Cleveland, O. | July 12 |
| Aug. 15. | Architectural competition, | Atlanta, Ga. | July 12 |
| Aug. 22. | Drainage canal, | Chicago, Ill. | June 28 |
| | Advertised, Eng. News, June 28 to Aug. 14. | | |
| Sept. 1. | Electric lighting, | Portland, Ore. | June 21 |
| Sept. 3. | Bridge, | Dillon, Mont. | July 5 |
| No date. | Bridge work, | Bloomingdale, Mich. | July 12 |
| " | " Brick paving, | Lansing, Mich. | July 12 |
| " | " Sewers (20,814 ft.), | Le Mars, Ia. | July 12 |

## METAL MARKET PRICES.

LEAD.—New York: 3.35 to 3.45 cts. Chicago: 3.15 to 3.2 cts. St. Louis: 3.1 to 3.12 cts.

NAILS.—Pittsburg: $1.15 for wire, and 95 cts. for cut at mill, in carload lots.

FOUNDRY AND PIG IRON.—New York: $10 to $13. Pittsburg: $10.75 to $11.75. Chicago: $10 to $11.50.

TRACK MATERIAL.—New York: angle bars, 1.25 to 1.4 cts.; spikes, 1.5 to 1.7 cts.; track bolts, 2 to 2.1 cts. with square and 2.1 to 2.3 cts. with hexagon nuts. Chicago: angle bars, 1.25 to 1.35 cts.; spikes, 1.7 to 1.8 cts.; track bolts, 2.1 to 2.15 cts., with hexagon nuts.

RAILS.—New York: $24 to $25 at eastern mills and at tide water; old rails, $11.00 for iron, and $10.00 for steel; steel rails fit for relaying, $16.00 to $16.50; light rails, $22 to $24; girder rails, $21 to $24. Pittsburg: $24 for standard sections. Chicago: $25 to $27; old rails, $10.50 for iron and $6.50 to $9.00 for steel.

STRUCTURAL MATERIAL.—New York: beams, 1.4 to 1.5 cts.; channels, 1.4 to 1.5 cts.; angles, 1.3 to 1.35 cts.; tees, 1.5 to 1.6 cts.; universal mill plates, 1.25 to 1.35 cts.; steel plates, 1.35 to 1.4 cts. for tank, 1.45 to 1.5 cts. for shell, 1.6 to 1.65 cts. for flange, 1.75 to 2 cts. for ordinary firebox, 2 to 2.25 cts. for locomotive firebox. Pittsburg: beams, 1.25 to 1.3 cts.; channels, 1.25 to 1.3 cts.; angles, 1.2 to 1.35 cts.; tees, 1.35 to 1.4 cts.; universal mill plates, 1.2 to 1.35 cts.; steel plates, 1.25 to 1.3 cts. for tank, 1.4 cts. for shell, 1.45 cts. for flange, 2½ to 3 cts. for ordinary firebox, and 3.35 to 3.4 cts. for locomotive firebox. Chicago: beams, 1.5 cts.; channels, 1.5 cts.; angles, 1.45 cts.; tees, 1.65 cts.; universal plates, 1.45 cts.; steel plates, 1.45 to 1.55 cts. for tank, 1.5 to 1.6 cts. for shell, 1.65 to 2.1 cts. for flange, 1.65 to 5 cts. for firebox.

## INDUSTRIAL NOTES.

THE INDIANA STEEL CASTING CO. will erect a brick and iron building, 200 × 90 ft., at Anderson, Ind., for its new works. Pres., John McKinnon, of Chicago.

RUSSELL & CO., of Massillon, O., have the contract for a compound condensing Corliss engine for the electric power plant of the Second Avenue Street Ry. Co., of Pittsburg, Pa.

THE ABENDROTH & ROOT MFG. CO., of New York, has opened an office at 1,422 Monadnock Block, Chicago, with Mr. George K. Hooper, M. E., formerly its representative at Rochester, N. Y., in charge.

STEEL TIES.—The Daniels Steel Railway Tie Co., of Youngstown, O., has an order for 4,000 ties for the Terre Haute, Ind., street railway. The tie is a corrugated steel plate, with bolted clamps for the rail attachments, and weighs 60 lbs.

THE GENERAL COMPRESSED AIR CO., of Jersey City, N. J., has been incorporated at Trenton, with a capital of $1,000,000, of which $10,000 are paid up. Robert L. Lawrence, Jersey City, N. J.; George S. Stitt, Bayonne, N. J.; Lawrence S. Mott, Newark, N. J.

THE JERSEY CITY GALVANIZING CO., of Jersey City, N. J., has put in machinery for the manufacture of riveted sheet iron piping, plain and galvanized, and makes a specialty of house leader pipe at a low cost. It has also machinery for corrugating, crimping and curving sheet iron for roofing and architectural work, as well as facilities for general galvanizing.

THE FLYNT BUILDING & CONSTRUCTION CO., of Palmer, Mass., has the contract for a felt mill at Greenbush, N. Y., designed by Lockwood, Greene & Co., mill engineers and architects, of Boston. The main building will be 257 × 60 ft., with three stories and basement, and an extension 70 × 80 ft. for the engine and boiler house. There will also be a wool storage building 50 × 150 ft. The buildings will be of slow-burning construction and fitted with automatic sprinklers for fire protection.

THE BUFFALO STEAM PUMP CO. has established new works at North Tonawanda, N. Y. The buildings are of brick with iron truss roofs. The erecting shop, 40 × 80 ft.; foundry, 165 × 80 ft.; cleaning room, eling crane; the machine shop is 75 × 110 ft.; pattern shop, 40 × 80 ft.; foundry, 105 × 80 ft.; cleaning room, 40 × 40 ft.; engine room, 16 × 20 ft.; boiler room, 35 × 55 ft. The shops and the real estate cost $50,000; the equipment and stock are valued at $155,000. Pres., C. B. Hill, vice-pres., C. M. Farrar; treas., George C. Herschell.

NEW COMPANIES.—Traction Construction Co., Denver, Colo.; $50,000; Geo. E. Hart, W. B. Doud and A. K. Kerkham.——Combination Bridge Co., Sioux City, Ia.; to build a highway bridge across the Missouri River; $2,000,000; Wm. Reynolds, W. C. Silverthorne and Wm. Faxon, Jr.——Lansdowne Gas Co., Chester, Pa.; $1,000, with $100 paid up; Treas., Wm. S. McManus, Thurlow, Pa.——Suburban Gas Co., Chester, Pa.; $1,000, with $100 paid up; Treas., Wm. S. McManus.——Griffiths & McDermott Construction Co., Chicago, Ill.; $75,000.——Perkins Water Tube Boiler Co., La Crosse, Wis.; W. W. Cargill.

## MUNICIPAL BOND MARKET.

New, York, July 10, 1894.

Such business as is just now being done in the various municipal bond markets is confined to the purchasing of new issues in blocks and the completing of a few unfilled investors' orders. The demand that, it was supposed, would be created by the efforts of investors to place the big July dividend and interest disbursements has been almost completely dissipated by the unsettled conditions that have developed in the financial situation. Strike news has completely killed the bond business. Investors have everywhere held off, preferring to await the outcome in the big labor struggle before engaging in new ventures, and the amount of business that has been done over the boudbrokers' retail counter is ridiculously small, when comparison is made with the flood of orders that generally makes its influence felt after such heavy disbursements of money as occur at this time of the year.

Naturally the Western bond houses complain most of the demoralization of the bond market, so far as the volume of transactions is concerned. Firms like Breese & Cummings, N. W. Harris & Co., Farson, Leach & Co., A. O. Slaughter & Co. and other people financially prominent in the West are agreed that the strike troubles have absolutely killed the market for investments. There are many inquiries for cheap bonds, but no purchases are reported, the people with money being made absolutely afraid by the threatening aspect of Debs, Howard & Co.'s play at government.

Eastern bond people are waiting with some interest and curiosity to see how far the Western labor troubles will affect the bidding for the $3,000,000 city of Chicago drainage bonds, offers for which will be opened to-morrow. Only one New York house made any bid for the last issue of Chicago bonds some two weeks ago and they are not likely, in view of the revelations that have been made as to Chicago's ability to restrain lawlessness and protect property, to be wildly overanxious to secure these drainage bonds. The bonds in question bear 4 per cent. interest, run 20 years and cannot be sold at less than par and accrued interest. The last bonds of this lot that were sold on a 5 per cent. basis brought 101.79.

People who are anxious to secure gilt-edged securities have a chance to safely invest money in the bond offerings announced yesterday by the Comptroller of Brooklyn and the Treasurer of Kings County. Brooklyn wants to sell $725,000 worth of 4 per cent. bonds of the following issues: Brooklyn Bridge bonds, $175,000; Local Improvement bonds, $200,000; Sewer, Relief and Extension bonds, $200,000; Water Loan bonds, $100,000; Soldiers' and Sailors' Monument bonds, $50,000. Comptroller Corwin says he will be able to easily dispose of the entire issue.

The Kings County offerings are as follows: $150,000 4 per cent. County Farm Loan, due 1904, and $200,000 Armory bonds bearing 4 per cent. interest and maturing between 1903 and 1908.

New York is also in the market to sell bonds. Comptroller Fitch having been authorized to sell some bonds to pay for new school houses, park lands, street improvements, etc. Details of the offering will be made public within a day or two. Prices for these securities will undoubtedly be very high, as the Philadelphia bonds recently awarded are now selling on a basis netting investors 3.12 to 3.15 per cent. The Comptroller has just presented a statement showing that the debt of the city of New York increased during the six months ending June 30 $3,577,227, to $104,330,634.

A few days before the annexation of the town of New Utrecht to Brooklyn, the town authorities authorized the disposal of $500,000 improvement. They showed great forethought in th's. In the first place, New Utrecht received the benefit of all the higher credit that large population and resources lend to a municipality, and then the issue was much larger than would have been made after annexation. The bonds were in $100,000 lots and were purchased as follows: Coffin & Stanton, $200,000; D. A. Moran, $100,000; Street, Wykes & Co., $100,000, and F. C. Schlesinger, $100,000.

Another recent municipal bond sale of importance was the disposal of $200,000 Allegheny City, Pa., 4 per cent. Street Improvement bonds and $80,000 4 per cent. Electric Light bonds, to run from 20 to 30 years. There were 12 bidders, and the bids ranged from par and interest to the offer made by the successful bidder, the National Bank of Western Pennsylvania, 106.275 and interest. The last previous issue of Allegheny City bonds was awarded at 105.06, and bond dealers were considerably surprised at the high price realized at the sale. Pittsburg dealers were well advised by their Eastern correspondents not to bid too strong, as the bond market was displaying a hesitating tone.

It is reported in local bond circles that the syndicate which took the Philadelphia City loan still had a considerable number of bonds on hand unsold, but the Buffalo bonds recently awarded at par are understood to have been disposed of to-day at a good advance on the purchasing price.

MUNICIPAL BONDS.

| | Price. |
|---|---|
| City of Pueblo, Col., Gen. Fund 6s | 113 |
| County of Flathead, Mont., 20-year, Gold 6s | 107⅝ |
| City of Bartow, Fla., 20 year 6s | 102 |
| Williamsbridge, N. Y., Highway 6s | 136½ |
| City of Bethany, Mo., Gold 6s | 105¾ |
| Knightstown, Ind., 6s | 111½ |
| County of Park, Mont., Gold 6s | 109¼ |
| County of Fergus, Mont., Gold 6s | 106 |
| City of New Whatcom, Wash., Gold 6s | 105¾ |
| School District of Brainerd, Minn., 6s | 108¾ |
| City of Meridian, Miss., 6s | 107½ |
| County of Bexar, Tex., Gold 6s | 103½ |
| City of Omaha, Neb., 5s | 111 |
| City of Jefferson, Ia., 5s | 102½ |
| City of Hastings, Neb., 5s | 102 |
| City of Salt Lake, Utah, Gen. Fund 5s | 103¼ |
| City of Tacoma, Wash., 20-year 5s | 101 |
| City of Dayton, O., School 5s | 107½ |
| County of Portage, Wis., Refunding 5s | 107⅝ |
| City of Findlay, O., School 5s | 105 |
| City of Sheldon, Ia., School 5s | 101½ |
| City of Brooklyn, N. Y., Pub. Market 4s | 110¼ |
| City of Elmira, N. Y., 4s | 105⅞ |
| City of Niagara Falls, N. Y., Sewer 4s | 105½ |
| City of Auburn, N. Y., 4s | 108½ |
| City of Cleveland, O., 4s | 104⅝ |
| City of Manchester, N. H., 4s | 106½ |
| Town of Methuen, Mass., 4s | 107 |
| City of Waterbury, Conn., 4s | 105½ |
| City of Chicago, Ill., Gold 4s | 104¼ |

## RAILWAY STOCK MARKET.

New York, July 10, 1894.

Considering the genuine gravity of the situation, dominated as it is by the big railroad strike, the railroad stock has held with a firmness truly remarkable when one takes into consideration how genuinely alarming surrounding conditions are. No previous market record shows any such resistance to bad news as has been exhibited of recent days by the railroad stock list. There has been practically no decline in the list during all the bad news. A table of comparative prices shows that for the week ending last Saturday 20 active stocks closed at an average price of $51.50. On June 30 the average price was $52.30, thus showing a loss of 71 cents for the week, a fact that would not have had much credence had it been stated a few weeks ago.

It is not very hard to explain the reason for this unusual state of affairs. There has been hardly any liquidation of investors' holdings. It can be fairly stated that stocks never were in as strong hands as they now are. The people who now hold them acquired them at low figures on the tremendous liquidation of small holdings that accompanied last year's panic in Wall Street, and, after they demonstrated their ability to carry their stocks through last year's panic, they do not see why they should sell at the present juncture. What liquidation that may ensue by reason of a continuation of the labor troubles must come from foreign sources, and this makes London quotations a particularly valuable index as to the general run of sentiment abroad. So far the soundness of the Administration's policy toward the strikers has maintained confidence abroad in "Yankee Rails," but the foreigner is easily scared, and he may any day start to letting his investments go.

However little quotations may reflect the state of affairs, there is no question as to the gravity of the situation. The point is made that most of the roads of the country up to the strike had all they could do to make both ends meet, even by exercising the most rigid economy. When the effects of the strike are made manifest, the maintenance of dividends by some of the Granger roads will be found to be a matter of the utmost difficulty. The strike is now on only about ten days, yet the losses have already been tremendous. Some of it may be recovered, but the whole Illinois State government is seemingly sharing in Mr. Altgeld's anarchist proclivities, to judge from the Chicago city attorney's blustering language, and the collection of damages will be tedious and expensive.

The paralyzing effects of the strike are nowhere better demonstrated than by the record of eastbound shipments from Chicago, which last week were only 11,666 tons as against some 43,000 the week before and 45,733 tons during the same week of last year. The boycott is killing all business. Earnings for the last week of June and the first week of July will make a terrible showing. Indeed, many of the roads have determined not to make any reports for the current periods. Vice-President Bond, of the St. Paul, said to-day: We laid off all our employees in our offices, and some of them were employed as watchmen. The executive departments were not in operation and the returns are so meager that there are really no figures to compile. Besides, there was very little freight moved. Merchants would hardly offer freight for shipment with the prospects of having it stolen, burned, ditched or sidetracked. Then again the roads were in no position to receive freight."

The whole market now hinges upon the suppression of lawlessness in the West. A settlement of the strike will have an immediate beneficial effect upon railroad stock prices.

| Railroad stocks. | Closing prices July 10. |
|---|---|
| Alton & Terre Haute | 32 |
| Atchison, Topeka & Santa Fe | 5¼ |
| Baltimore & Ohio | 70 |
| Canada Southern | 48 |
| Chesapeake & Ohio | 16 |
| Chicago, Burlington & Quincy | 73⅞ |
| Chicago & Northwestern | 103¼ |
| Chicago, Milwaukee & St. Paul | 58¾ |
| Chicago, Rock Island & Pacific | 65⅝ |
| Clev., Cin., Chicago & St. Louis | 35 |
| Delaware, Lackawanna & Western | 159 |
| Delaware & Hudson | 126 |
| Lake Shore & Mich. South | 127¾ |
| Louisville & Nashville | 43¾ |
| Missouri Pacific | 25¾ |
| Missouri, Kansas & Texas | 12¼ |
| Mobile & Ohio | 18 |
| New Jersey Central | 107 |
| New York Central | 96 |
| New York & New England | 5 |
| N. Y., New Haven & Hartford | 177 |
| N. Y., Chicago & St. Louis, 1st pfd | 60 |
| N. Y., Lake Erie & Western | 13⅜ |
| N. Y., Ontario & Western | 14½ |
| N. Y., Susquehanna & Western | 13¾ |
| Northern Pacific | 3½ |
| Northern Pacific, pfd | 13¾ |
| Philadelphia & Reading | 16¼ |
| Richmond Terminal | 11⅛ |
| St. Paul & Omaha | 35¼ |
| Southern Pacific | 17¾ |
| Texas Pacific | 8⅝ |
| Union Pacific | 10¼ |
| Wabash, pfd | 13⅝ |
| Wheeling & Lake Erie | 9¾ |

BOSTON RAILROAD STOCKS.

| | July 10. |
|---|---|
| Boston & Albany | 203½ |
| Boston & Maine | 146 |
| Fitchburg | 40 |
| Old Colony | 179 |

PHILADELPHIA RAILROAD STOCKS.

| | July 10. |
|---|---|
| Lehigh Valley | 36¼ |
| Pennsylvania Railroad | 48 |

## NOTICE TO WATER-WORKS CONTRACTORS.

Northfield, Minn., June 29, 1894.

Sealed proposals for the construction of a system of water-works will be received by the City Council at its rooms until 8 o'clock P. M. of the 27th day of July, 1894, at which time they will be publicly opened and read at a meeting of the Council held for that purpose.

The work will comprise as follows:

1. The furnishing f. o. b. cars at Northfield of approximately 30,600 lineal feet of 4-in. to 12-in. cast iron water-pipe with necessary special castings.

2. The furnishing f. o. b. cars at Northfield of fifty-one 4-in. and 5-in. fire hydrants and thirty-three 4-in. to 12-in. gates with cast iron gate boxes.

3. Laying of the above pipe and setting all valves and hydrants.

4. A brick pumping station and chimney.

5. A steam pumping plant, comprising one compound fire pump, and one boiler, with appurtenances, etc.

6. A reservoir."

Bids will be received for the entire work complete, or separate bids for any one or more of the six portions as above divided. The right is reserved to accept such single bid, or combination of bids, as may be deemed for the best interest of the city; also to reject any or all bids.

A certified check, made payable unconditionally to the order of the City Treasurer of Northfield, Minn., must accompany each bid; the check to be in an amount equal to $50 for each portion bid upon.

Proposals must be made upon blank forms furnished for that purpose, and all proposals not in conformity with this notice will be considered as informal and be rejected.

Plans and specifications will be *on file* and can be seen and blank forms of proposal obtained after July 9, at the offices of the undersigned in Northfield, and the engineer, CHAS. F. LOWETH, 94 East Fourth street, St. Paul.

By order of the Council.

M. W. SKINNER,
Chairman Water-Works Committee.
CHAS. F. LOWETH,
Consulting Engineer, St. Paul, Minn. 28-1t

## NOTICE TO CONTRACTORS.

McDONALD, PA., WATER WORKS.

Sealed proposals will be received at the office of the Secretary of the Citizens' Water Company, at McDonald, Pa., until July 16, 1894, at 7:30 P. M., for the construction complete, according to plans and specifications, of the McDonald Water Works system.

The work including the following:

A. A crib dam.

B. A pumping station.

C. Pumping machinery of 2,000,000 gallon capacity.

D. Steel tank to hold 800,000 gallons.

E. Furnishing 1,700 tons of cast iron pipe.

F. Furnishing valves and hydrants.

G. Laying ten (10) miles of pipe with necessary valves and hydrants.

Bids will not be received for the above work as a whole, and the Water Company reserves the right to reject any or all bids.

Each proposal must be accompanied by a certified check equal to 3% of the amount of the bid, but no check will be less than $200.

Plans can be seen and specifications procured at the office of the Secretary, Campbell Building, McDonald, or at the offices of Potter & Folwell, 137 Broadway, New York, and 700-1 Lewis Block, Pittsburg, Pa., on and after July 11, 1894.

E. S. McWREATH, Secretary.
POTTER & FOLWELL, Engineers. 28-1t

## PROPOSALS FOR WORK AT BLOCK ISLAND.

Sealed proposals will be received at the office of the Town Clerk of New Shoreham, Block Island, R. I., until 12 o'clock noon on the 24th day of July, 1894, for 350,000 cubic yards of dredging, 750 feet of pile sheathing and 6,400 tons of stone required for cutting and protecting a channel connecting the Great Salt Pond with the ocean, in accordance with drawings and specification, copies of which may be had on application at this office.

The committee will reject all bids received after the time herein stated for opening the same.

Proposals must be inclosed, sealed and marked "Proposal for Dredging at Great Salt Pond," or "Proposal for Breakwater at Great Salt Pond," or "Proposal for Pile Sheathing," and addressed to Edward P. Champlin, Town Clerk, New Shoreham, Block Island, R. I.

EDWARD P. CHAMPLIN,
For the Committee and Town Council of New Shoreham. 28-2t

## SEWER CONSTRUCTION.

Mayor's Office, Charlottesville, Virginia,
July 6, 1894.

Sealed proposals will be received by the City of Charlottesville, Va., at the Mayor's office until 12 M., Thursday, July 26, 1894, for the complete construction of a system of small pipe sewers in district No. 1, or Schenck's Branch District.

Also, at same time and place, sealed proposals will be received by the city for furnishing vitrified sewer pipe f. o. b. Charlottesville.

Blank forms of proposals, specifications and instructions will be furnished upon application to the engineer in charge, and plans may be seen at his office.

A certified check, or equivalent, to the amount of $500 must accompany each proposal.

The right to reject any bid or all bids is reserved.

JOHN S. PATTON,
Mayor.
JOHN M. GODWIN,
Clerk.
N. WILSON DAVIS,
Engineer in Charge. 28-2t

U. S ENGINEER OFFICE, 24 WEST CONgress St., Detroit, Mich., June 28, 1894.—Sealed proposals for Power House and Office Building for the 800-ft. lock, St. Marys Falls Canal, will be received here until 2 P. M., July 28, 1894, and then publicly opened. Information furnished on application. O. M. POE, Col. Corps of Engrs. 26-3t